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Comparison of Electric and Steam Draglines on the Miami

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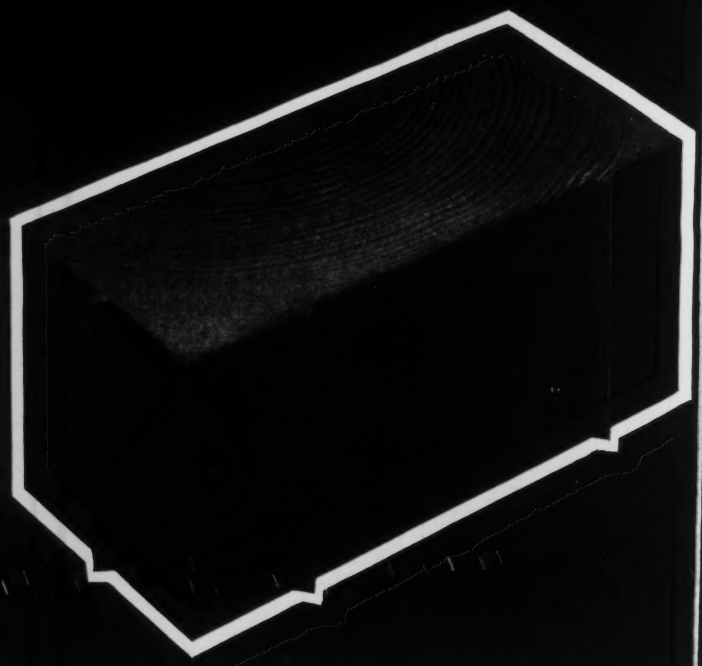
KREOLITE LUG WOOD BLOCKS

"The Paving that's Saving"

THE greatest contributing factor, in determining the principal business thoroughfare of a city, is the character of the pavement used. A smooth, well constructed and well selected pavement attracts business and traffic like a magnet. The magnet, which attracted the business in the case of the accompanying photograph consisted of a KREOLITE, Lug Wood Block Pavement.



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ENGINEERING NEWS-RECORD

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AND CONTRACTING

E. J. MEHREN
Editor

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Dragline Operation

THE comparison in this issue of steam and electrically operated dragline excavators indicates that (1) the costs of excavation are not greatly different, (2) the margin in favor of electricity is entirely saving in attendance, and (3) the superiority of the electric machine is its greater desirability as a place in which to work. A smaller crew and better working conditions for that crew are important advantages. Both help to reduce labor turnover and to increase the efficiency of labor. Men work better when their working conditions are cleanly and pleasant and they remain longer on the job. These are truths too well known to be questioned even by construction managers who generally have been more slow to appreciate their practical importance than have factory managers. They are important factors in bringing about the substitution on construction equipment of the motor and the gas engine for the steam boiler and engine.

Army Engineers Early Training

FEW civilian engineers regard West Point as even an elementary engineering school, much as they admire the basic quality of its instruction, and fewer still consider the early education of the army engineer officer—in the self-perpetuating Engineer School and as an executive under the orders of his superior in the district office—at all comparable in training value to that received by the civilian in the engineering school and in the close-to-the-job experience of the first years after graduation. The army engineer in his earlier years certainly needs more non-military engineering education and association. Judging from certain parts of the recent report of the Chief of Engineers, abstracted on another page, the Corps of Engineers now has some respect for these lay views, for it will be noted that for two years a considerable number (77 last year and 44 this year) of younger officers have been taking engineering courses at two of our leading technical schools—and in addition, some officers have been detailed to industrial concerns, though the number is not stated. We are advised, however, that three officers are with railroads. Lack of the common touch and superficiality have been charged against army engineers. If reformed methods of early training can remove the causes of these criticisms the Corps will find less opposition in the future.

Briand and Poincaré

LAST week we spoke hopefully of the prospects of an economic conference called to meet in Genoa in March. It seemed then that good must surely come from it. But what a change in the situation in one short week! Briand, who had learned the spirit of compromise, even though his demands regarding the method of securing French security did not accord with that of the rest of the world, has fallen and in his place is Poincaré, the irreconcilable. For the moment Europe fears that there is again dominant in France the spirit that caused the rest of Europe to declare many a time since the armistice that France was the greater obstacle in the way of European peace. The British, upon whom more than any one else depends the satisfactory working out of Europe's ills, are fearful of the attitude that the new premier may take. Hope is reposed, however, in the well known fact that the responsibility of office breeds conservatism and that the awakening of France to the fact that she is rapidly losing the sympathies of the great majority of the people in Great Britain and America may make for a more tolerant attitude and bring about in Poincaré, as it did in Briand, the spirit of compromise. The Genoa conference, despite Briand's fall, is to go forward.

Enjoining the Employer

EMPLOYERS no less than employees, must respect the sanctity of labor contracts. That is a generalization that could be made in the abstract at any time. It is pertinent now, however, because Justice Wagner of the New York Supreme Court last week enjoined the Cloak, Suit & Skirt Manufacturers Protective Association from "combining or conspiring in any way" to violate the contract with the International Ladies Garment Workers Union. The facts in this case have been spread before the New York public for some months and the opinion has been strongly formed that the employers were in the wrong. They and their employees are working under a contract that was to run until June 1, of this year. However, the employers decided to put their employees on piece work, instead of on a time basis, and to lengthen the working week. To this the employees objected, as being violative of the present contract. A strike ensued at the middle of November, and the court action here discussed was the result. The case has special importance because it is believed to be the first one in American industrial history in which a labor union has obtained an injuction to hold employers to a working agreement. Another interesting angle is that the union's president declared that it would instruct its counsel to "institute proceedings to recover from the Protective Association and its members the full amount of damages sustained by the workers on account of the strike which has been forced upon them." Obviously, there will be the point of law here that the employees actually went out on strike and were not locked out. Nevertheless, if in the Danbury Hatters case it was possible for the employers to recover damages from their men, it would seem, without minute inquiry into all the facts, that there would be liability for damages from the employers in the present case. In any event, the injunction is notice to all employers that they cannot violate their labor agreements with impunity.

Responsibility for Corrupt Trade Practices

ELSEWHERE in this journal a correspondent expresses the belief that owners, not contractors, should bear the large measure of responsibility for corrupt practices in the building industry. It is his assertion that the owner, anxious that his work be completed rapidly, may be willing to wink at corruption. With such a position we must take issue. In the first place were the owner entirely to blame, and we certainly believe him not to be, the contractor would not be relieved of any responsibility. It is his duty to give the public—which must pay for expensive work made so through strike insurance or what-not levied against it—the least costly work consistent with good workmanship. Though the contractor be doing his job for a consideration, his ethical position is as clear as that of any other public servant. The stability of the industry is dependent upon the public's confidence. If the owner be tempted, the contractor has an opportunity to do real service that should not be passed by. The man who is paying the cost of the construction is usually too shrewd to pour needless dollars into the work for the sake of getting it done rapidly. Competition in letting space is usually too keen to admit such practice, unless the work be strictly speculative in character, or unless space to rent or lease is at a premium and the time element is the controlling consideration. In the second place, the contractor has been found guilty of complicity in corrupt practices. So let us reiterate the point that in the activities of trade associations and the building industry in general the contractor should point the honorable way.

Increase Patent Office Salaries

IN THESE days of enforced government economy, pleas of special interests for increases in appropriations fall on deaf ears. Every government expenditure has some one who thinks it necessary to the life of the nation. Congress, in despair of making just discrimination, is apt to throw out all requests for increased appropriations and particularly for increased salaries. The conditions in the Patent Office are so manifestly disturbing, however, that the salary increases there asked in H. R. 7077, which has just passed the House, should become the first order of business in the Senate. A self-supporting institution, dependent on its efficiency for the continuance and ability of its personnel, the Patent Office is now going daily further behind in its business and piling up more and more litigation because of the difficulty of getting and keeping trained examiners at the ridiculous low wage scale now in force. The bill now before the Senate does not add much to the expense of government but it does offer enough salary to enable self-respecting engineers and lawyers to live in Washington without an impossible sacrifice for the public good.

Stopping Bad Practices

IT IS quite apparent that costly limitations are placed upon building in New York City by union organizations. Their working regulations have been full of practices that have put penalties on the contractor and necessarily, therefore, on the owner and the tenant. Not alone have the money penalties been freely imposed, but restrictions in working conditions, the number of apprentices allowed in certain trades on certain jobs, the limitation of the use by the contractor of mechanical appliances, the insistence that work which rightly belongs in the shop be done on the job, the interference of unions with employers' business activities: all these have been extremely costly.

Certain of these practices are to be eliminated, if the promises of the Building Trades Council can be relied upon. Conferences between the counsel for the Lockwood Committee and the council have resulted in a decision as to what practices, in a general way, are to be dropped. A threat of legislative curtailment of power has led the unions to realize that the public has an immense interest in their deliberations and operations.

Though the objections to union practices are given in detail in a pamphlet issued from the offices of the counsel for the Lockwood Committee, and outlined in last week's News Section, no definite settlement has been reached. The public should know these practices and should take an active hand in getting rid of them and in seeing that they do not again creep into union operations. As we have pointed out before, here is a great work for local chambers of commerce or other strong civic bodies. That which the Lockwood Committee is doing in New York should be done wherever union practices are wasteful.

The American Concrete Institute

NEXT month the American Concrete Institute meets for the first time in many years outside of Chicago, if the two war meetings at Atlantic City be excepted. This selection of Cleveland is experimental, an attempt to attract a greater variety of attendance by successive meetings in different parts of the country, so that interest in the society now maintained principally by the *Proceedings* may be strengthened by the appreciation that attendance on the convention is bound to develop. The institute has taken on renewed vigor in the past two years. A permanent secretary, regular news-letters and a thoughtful program of intention and procedure have done much to spread among engineers and contractors the good work the society is doing and, what is more important, can do. Its membership has now reached as many as in the early days of enthusiasm in its predecessor, the National Association of Cement Users, and its committees are better organized than ever before.

The American Concrete Institute has a real place in our technical societies. In it are brought together all of those who are interested in the designing and building of concrete structures and they are united there in the single purpose of making better and more economical concrete. The contractor members are not in as business men but as concrete builders, the engineers not solely as the arbitrator between contractor and owner but as designers and supervisors of construction. The material men meet in it the users of their materials. The aim of all of them is identical—better concrete. In the Institute can be joined, as nowhere else, the divergent views into the compact whole, which is what concrete needs.

The Cleveland meeting is the first one after the reorganization of committee work, which was decided upon last year at Chicago. Intensive work in certain lines of activity, notably concrete products, contractor's methods and housing, was planned. These subjects, together with a discussion of the Joint Committee report, from the point of view of the Institute's committees, will form the nucleus of this year's program. It promises fruitful results, but it can be best carried out by a representative attendance, which it should have.

Endurance of Material

IN SO FAR as engineering may be described as the art of constructing for permanence, rather than merely constructing, those questions and problems that are concerned with the mortality of material, its inability to endure in service without limit, are among the ultimate problems of the underlying science. In the last analysis endurance failure is the controlling factor in every undertaking of constructive engineering; or, more accurately, it is one of two factors: The loss of matter through attrition and chemical attack, and the loss of strength through oft-repeated stressing. The latter, to which custom has limited the term "endurance failure," occupies a position of peculiar distinction among the mysteries of materials. Some definite knowledge concerning it has been produced in the laborious and careful researches on fatigue reported in last week's issue by Prof. Moore. The results obtained, limited as they are, open up the prospect that fatigue phenomena may in time be wholly divested of their cloak of mystery, and that we need then no longer make allowance for fatigue in our factors of safety, or try to provide for them by the empirical working out of designs.

It is now established that endurance failure under alternating stress—which occurs throughout a large range below the static failure point of the material, and in this range follows a simple mathematical law with great accuracy—suddenly ceases to occur when the stress is reduced to a certain definite limit. Stresses below this limit may apparently be repeated an endless number of times without causing fracture. It is established also that the heat generated in a piece of metal by alternating stress, which can be measured to sufficient accuracy after less than a minute of testing, is generated at a much more rapid rate per unit of stress when the stress is very high than when it is low, and that the rate abruptly changes at a certain limiting stress, identical in every repetition of the test series. It is shown further that, throughout a large series of comparative tests, the limiting stress thus determined by heating is the same as the endurance limit found from the long-time alternating-stress fatigue experiments. No relation appears between this limit of fatigue strength and the static properties which have usually been thought determinative, such as elastic limit, or ductility. On the other hand, the fatigue strength seems to bear a direct proportion to the ultimate strength as well as to the hardness of the material; but the correspondence is erratic enough to suggest that no simple physical law is in action here, and that perhaps the endurance limit is just as independent a variable as elastic limit, ultimate strength and toughness themselves. This point is of minor importance at present, however. The outstanding fact is that an endurance limit has been determined with great certainty, that means have been found—namely, the heating test—for determining this limit in an experiment of a few minutes' duration, and that by keeping service stresses below this limit we may expect to obtain permanent service from material, without any fatigue or "crystallization." These statements apply only to steel, as no other material was experimented upon.

Some, if not all, of these facts are new only in degree but not in kind. Wöhler, half a century ago, by his pioneer investigations on fatigue, was led to conclude that there is a definite endurance limit, below which no fatigue action takes place. Subsequent workers, mainly Stromeyer, have inquired into the generation of heat in repeated stressing of a test specimen. The dominating influence of surface imperfections on endurance failure has been known for a long time, from practical experience as well as from laboratory data, and together with the similar influence of sharp corners or abrupt changes of shape is the most definitely known and in some respects the most important fact concerning endurance. But Prof. Moore has made certain that which with Wöhler was nothing more than shrewd inference, and he has not only converted the heating test into a scientific method rather than a laboratory plaything, but he has positively identified the heating limit as the stress-endurance limit. Finally, in demonstrating a close correspondence between endurance and both strength and hardness, he has opened up a wide field for exploration.

All that he reports deals with alternating stress, that is, change from tension to compression of equal numerical value and back again. About other possible endurance-failure actions we are told nothing, although a few reversed-torsion experiments were made. For instance, shearing stress may perhaps be capable of producing fatigue failure. It is true that shear fatigue is practically negligible for either the civil or mechanical engineer's working needs, but the same is true of fatigue resulting from alternation of tension and compression in equal amount, since such stress occurs but rarely in practice. Repetitive stress of constant kind (for instance, tension ranging from zero to maximum or from a low tension to a high tension), the influence of small variations of stress superimposed upon a high steady stress, the influence of occasional very high or suddenly applied stresses upon the progress of fatigue under a moderate, oft-repeated stress, and similar points of inquiry are the ones that more directly correspond to service needs.

These sub-problems, of course, can be investigated only after the determination of the fundamental facts which the investigation so far has developed. But they are worth thinking about as indicating how vast is the field open for further fatigue research, and how important therefore the foundation that has been laid by the work just completed. It is necessary to remember, too, that unless the research is continued, and continued to very great lengths, its practical value to engineers will be small: the real fruits of the research lie in the results yet to be attained.

For the civil engineer there is one important teaching in the present results. Bridge and structural design has for years past been shaped in an important way by the belief that a member carrying reversed stress is more severely taxed, and hence is in greater danger, than one carrying a one-directional stress, whether steady or variable. This belief has been maintained with persistence in spite of the fact that the maximum stresses occurring in the service of bridges and other steel structures are low, in fact from the fatigue standpoint *very* low. Prof. Moore's work makes it clear that there is no justification for any such belief, since the endurance limit is well above any stresses likely to occur in bridge service, and below this limit no weakening effect of "fatigue" can be detected. It will be in the interests of progress in bridge practice, then, if the reversed stress allowances are speedily discarded, except where they refer solely to riveted joints.

Comparison of Electric and Steam Draglines at Miami

Similarity of Machines and Materials Enables Close Comparison—Accurate Costs and Performance Records Kept—Structural Weaknesses Determined

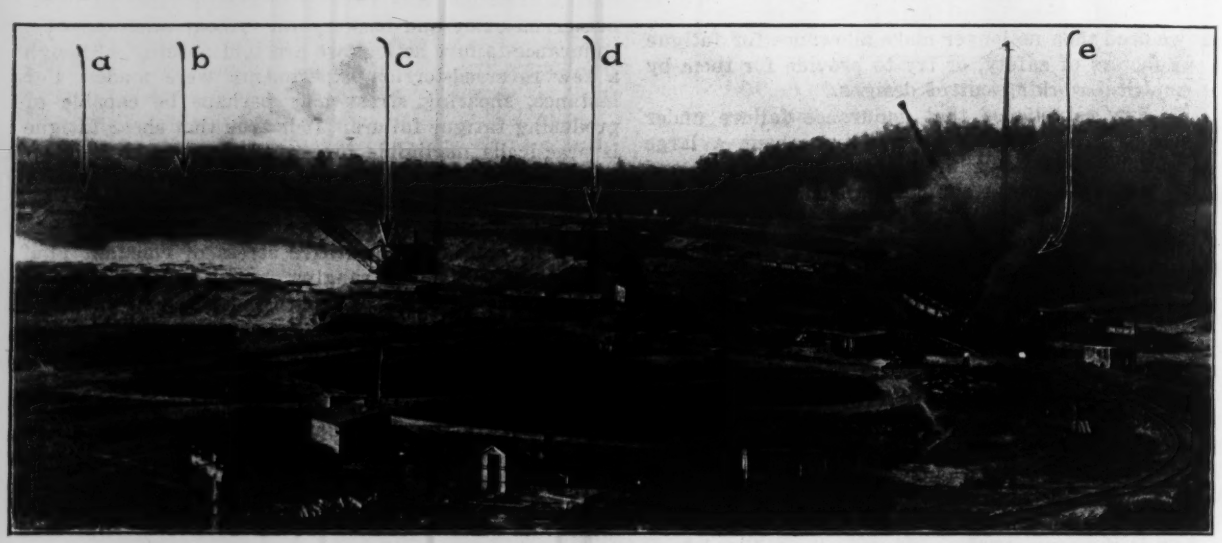
BY G. L. TEEPLE
Dayton, Ohio

COMPARATIVE performance and cost records of steam and electric dragline excavators on the flood protection works of the Miami Conservancy District decisively favor the electrical machine. It has been found cheaper, less troublesome, cleaner and more comfortable for the operators. It is more constantly reliable, more free from break-downs and delays, and is in general more efficient. These are the opinions of the engineers of the district and of the machine operators.

On the flood protection works, from 19 to 20 draglines have been in service most of the time, and in materials varying from clean sand to tough clay and solid rock. The motive power in nine of these machines has been electricity; in the remainder it has been steam. Under these conditions an unusual opportunity has been afforded for a comparison of the relative merits of the two sources of energy. At the Englewood dam, the opportunity has been exceptional, two machines there having been at work side by side for about three years. They are of the same size and the same make. They are excavating practically identical material under identical conditions, except that one is a steam machine, and the other an electric. A close watch has been kept on these two machines, and in recent months the costs have been kept in part with special reference to a comparison.

At Englewood, the borrow pit occupies the broad flat valley of the Stillwater River for about three-fourths of a mile immediately above the dam-site. The draglines are placed in tandem on the east pit edge, which extends roughly at right angles to the dam, and parallel to which the standard gage railway tracks are laid which carry the 12-yard dump-car trains to the dredge pump sump. The steam machine works the north part of the pit and the electric the south half, cutting successive slices from the pit edge, and dumping the excavated material into the cars alongside. These materials have been remarkably uniform, the upper 2 ft., approximately, being a rather light loamy top soil, and the underlying formation being an uncemented, easily-dug sand-and-gravel. The total depth of the pit is about 15 ft. The excavated portions form a pond or lake, 3 to 4 ft. deep, so that the bucket nearly always starts its work in water. The only impediments to free digging have been a few stumps.

Since it is evident that the test at Englewood furnishes no criterion of the performance of an electric machine in tough materials, it ought to be added that elsewhere on the conservancy work electric draglines have excavated tough clay, solid rock and Cincinnation formation, (inter-stratified clay, shale and limestone), with entire satisfaction, and with no indication that they would prove any less relatively efficient on such materials than on the materials at Englewood.



DRAGLINE EXCAVATOR OUTFIT AT ENGLEWOOD DAM
a—Steam pump for dragline boiler supply. b—Steam dragline, Bucyrus 24. c—Auxiliary steam dragline, Lidgerwood Class 13. d—Electric dragline, Bucyrus 24. e—Coal pile and clamshell unloader.

Both machines at Englewood are Bucyrus Class 24 type draglines. Each has an 85-ft. boom and a 4½ yard bucket. In working condition, the electrical machine weighs about 120 tons and the steam about 140 tons. They came onto the work new in the spring of 1918, and have since been in practically continuous use except for a few weeks during each of the last two winters. The work has been heavy and unremitting, through two 10-hour shifts, 20 hours a day, 6 days a week. The heavy strain is indicated by the fact that each machine was compelled, last winter, to go into the shop for a major repair. These facts are stressed to show that the test made, covering the months of May, June, July and August of 1921, and after three years of service like that indicated, is not one of picked machines in the "pink and prime" of condition, but of scarred

veterans that have been "through the war" and are still turning dirt out with little or no slackening in speed.

The steam machine has a main engine with double cylinders 10½ x 12 in. and a swing engine with double cylinders 8 x 8 in. The boiler is 58 in. x 14 ft. and carries steam at 125 to 150 lb. Coal is switched in from the railway main line a considerable distance, and is unloaded by clamshell on the ground near the dam site. A team carts the coal to the vicinity of the dragline, whence it is carried onto the machine by hand. Water for the boiler comes from a steam pump drawing its supply from the borrow pit pool.

TABLE I—COMPARATIVE COSTS OF OPERATION OF STEAM AND ELECTRIC DRAGLINES
Englewood Dam, Miami Conservancy District, May to August, Inclusive, 1921

Item	Electric	Steam	Electric Pr. Yd.	Steam Pr. Yd.	Electric Pr. Ct.	Steam Pr. Ct.
Labor	$6,926.25	$11,184.81	$0.0245	$0.0404	38.1	53.6
Supplies and minor repairs	1,993.24	1,821.27	.00704	.00657	11.0	8.7
Power	4,491.82	4,242.37	.0159	.0153	24.6	20.3
Cable	1,685.35	844.49	.00595	.00305	9.3	4.1
Depreciation	3,092.00	2,774.00	.0109	.0100	17.0	13.3
Total	$18,188.66	$20,866.94	$0.0644	$0.0753	$100.0	$100.0
Total work	283,024 c.y.	276,910 c.y.				
Cost pr. yd.	$0.0643	$.0753				

The electrical machine takes power from a special transmission line connected with the 33,000 volt circuit of the Dayton Power & Light Co. A transformer station at the dam steps this current down to 2,300 volts, whence it is distributed to the camp and work. The work circuit has two branches, one feeding the dredge pumps and the other the electrical dragline. The current is metered for the entire work circuit, and also for the dredge pumps, the difference giving the energy used by the dragline. This measure includes borrow pit line and transformer losses, but this, of course, does not effect the validity of the cost comparison. The machine takes current at 440 volts from three 75 kw. transformers in the borrow pit near it, connection being by three 4-0 flexible cables, the current being three-phase. These cables are 500 ft. long and are insulated with standard mining cable insulation which permits them to

TABLE II—COST OF EXCAVATION PER CUBIC YARD
By Class K, Lidgerwood Dragline, Germantown Dam

Labor, including erection, maintenance, operation and dismantling		$0.463
Power:		
Electric current	0.0114	
Transmission lines and substations	0.0026	
Labor of electricians	0.0020	0.0160
Supplies		0.0030
Repairs, incidentals and drag cables		0.0120
Depreciation		0.0153
Total		$0.0926

be laid along the ground. The current is three-phase, 60-cycle alternating. The dragline motors are of the slip ring, variable speed type. The load and hoist motor is of 200 hp., the swing motor of 75 hp., and a third motor, of 3 hp., works a small air compressor which operates the friction clutches on the cable drums.

While the air compressor on these machines works only the friction clutches, the drum brakes being operated by electrical devices, experience with other conservancy machines has shown that air is superior on the drum brakes also.

For presentation, Tables I and III the costs of operation are distributed under five main heads: Labor, Supplies and Minor Repairs, Power, Cable, and Depreciation. The minor repairs, being practically all materials, are bunched with the supplies for convenience. Cable is separated for exhibition on account of the special interest attaching to this item. Depreciation is an estimate only, based on first cost of the machine, but since the same percentage is applied to both machines, no material error will arise in the figures as used for purposes of comparison.

It should be carefully noted at the outset that the figures given are only for ordinary running expenses plus the rough depreciation measure. They do not include items of track construction and maintenance, nor electric line construction and maintenance, which are properly chargeable, the track items to the steam drag account, and the electric line items to the electric drag account. Neither are any overhead charges included (except 10 per cent on the cost of the coal in the pile.) Likewise the items of erection, major repair, dismantling and salvage are omitted, as being unknown or unnecessary to the purpose in view which is the comparison of the *relative cost* of moving the material by

TABLE III—COMPARISON OF COSTS, ELECTRIC AND STEAM DRAGLINES
Month by Month, at Englewood

Item	Electric	Steam
May, 1921		
Electric, work done 62,158 cu.yd.; cost per. yd. $0.073. Steam, work done 61,433 cu.yd.; cost per yd. $0.087.		
Labor	$1,858.42	$2,581.28
Supplies and minor repairs	636.72	399.85
Power	968.83	967.00
Cable	291.08	718.60
Depreciation	773.00	693.50
Total	$4,528.05	$5,360.23
June, 1921		
Electric, work done 68,950 cu.yd.; cost per yd. $0.060. Steam, work done 80,300 cu.yd.; cost per yd. $0.063.		
Labor	$1,583.87	$2,940.89
Supplies and minor repairs	305.71	248.76
Power	918.25	1,160.41
Cable	577.86	
Depreciation	773.00	693.50
Total	$4,158.69	$5,043.06
July, 1921		
Electric, work done 71,780 cu.yd.; cost per yd. $0.062. Steam, work done 61,625 cu.yd; cost per yd. $0.080.		
Labor	$1,697.15	$2,620.31
Supplies and minor repairs	359.82	432.96
Power	1,259.96	1,038.93
Cable	363.49	125.89
Depreciation	773.00	693.50
Total	$4,453.42	$4,911.59
August, 1921		
Electric, work done 80,144 cu.yd.; cost per yd. $0.063. Steam, work done 73,552 cu.yd.; cost per yd. $0.075.		
Labor	$1,786.81	$3,042.33
Supplies and minor repairs	690.99	739.70
Power	1,344.78	1,076.03
Cable	452.92	
Depreciation	773.00	693.50
Total	$5,048.50	$5,551.56

the two draglines. The omitted items will aproximately balance each other, as they would enter the final complete account. The running accounts presented will indicate the chief differences in the performance of the two machines. They will not, however, give any fair indication of *absolute* costs, a point which must be steadily kept in mind. (Compare the figures in Table II, which gives the final absolute costs for the Germantown machine).

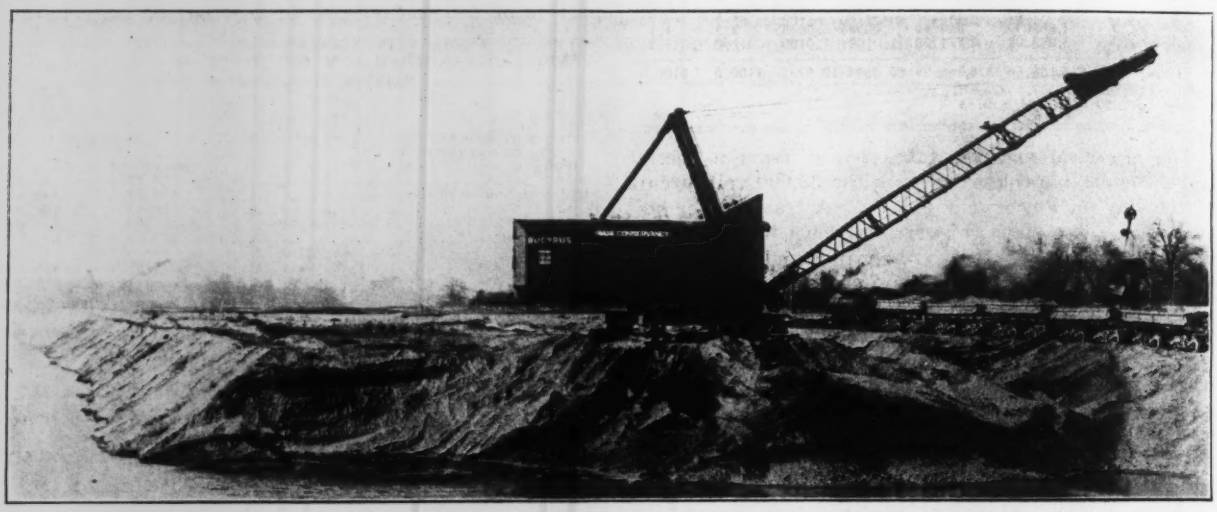
Labor is much the largest item in both accounts, being for the full period about 38 per cent of the total for the electric and about 53 per cent for the steam machine. It is also the item in which the electric machine shows its chief saving, the total labor cost being $6,926.25 against $11,184.81 for steam for the four months. The item includes all ordinary labor around the machines, that of the pumpman who attends the pump and boiler supplying feed water to the steam machine and also that of the team and man who haul coal. A pumpman is

required on both day and night shifts, but the coal team works during the day shift only. It is these two items which run the labor cost of the steam machine so much higher than that of the electric, together with the wages of the fireman and of the extra man required on the steam drag crew to help handle the coal from the pile on the ground to the machine. This will be clear from Table IV, which shows the itemized cost of the two crews. (Really four crews, there being a day and a night crew on each machine.)

The rates given are in case averages, there being slight variations due to length of service and other conditions. The rate for the team and man hauling coal is $8.80 per day.

The time costs of the chief electrician and of the master mechanic are not included in the labor costs as given, nor in any item. Each may be roughly estimated at $50 per month. Approximately divided between the two machines, as they are, their omission is not thought in the charge. The maximum demand meter is placed at the 33,000-2,300-volt transformer sub-station at the dam. The monthly bill from the power company is for the total energy used at the dam, and the amount of this to charge to the electric dragline is computed as a percentage from the readings of the various meters on the several dam circuits as described. The variation in the conditions is shown in Table V, the maximum demand being that for the entire work, the rate being the corresponding charge per kw-hr. the consumption given being that for the dragline machine alone, and the cost given making allowance also for discounts which vary with the gross bill.

A complete account of the electric power would include a pro-rated item covering the cost of the pole lines and transformers bringing the power from the Dayton Power & Light Co.'s circuit. As noted, it is not possible at this time to present such an item, the omission being balanced by a similar omission covering railway



ELECTRIC DRAGLINE AND TYPICAL EXCAVATING CONDITIONS

materially to affect the relative showing. The labor of shifting the borrow pit transformers is also not included. These transformers, attached to the electric dragline by 500 ft. cables as noted, are mounted on a sledge or "stone boat," and are moved down the pit, 850 to 900 ft. at a stretch, as the machines reaches the end of its tether. This is done during the "noon hour," ¾ hour long, two teams and ten men doing the work in that time. Also every four moves the "stubs" have to be cut off the branches of the borrow pit pole line, requiring four men about one day. This totals about $13 for labor per move, each move yielding about 70,000 cu.yd.

Supplies and minor repairs are almost entirely materials, the labor item in all cases but one being included in the pay of the crew, since the crews make these repairs at odd, favorable or necessary times.

Electric Power—This item, as entered in Tables I and III includes electrical energy only. This energy is derived, as stated, from the plant of the Dayton Power & Light Co. in Dayton, and the charge is made to depend not only on the actual energy used, but also on the "maximum demand" for energy on the entire work at the dam during the month, the theory being that this maximum must be reserved at the central station for possible use on the work and hence must be allowed for trackage, etc., necessary to bring the coal to the pile on the dam-site.

Of interest in this connection is the small loss sustained due to stoppages of the electric current in the power company's main circuit. Only four such shutdowns occurred during the four months considered. They were as follows: May 13, 3 hr.; May 27, ½ hr.; in June, none; July 28, 1 hr.; August 22, 4½ hr. Total, 9 hr. No overhead being included in the tables, this item, practically negligible in comparison, does not appear.

Steam Power—As given in Table I and III the cost of this item is that of the coal only, delivered upon the ground near the borrow pit as described. The cost per ton so delivered, including 10 per cent for field warehouse overhead, but not including switching and unloading charges, was $6.519. The high rate is due to the fact that the coal used was part of a large pile accumulated in part during 1920, to insure a certain supply, prices at that time being rather high. Freight charges may be reckoned at about $2.50 per ton, and switching and unloading at about 25c. the latter being by clamshell. The tonnage used was as follows; in May, 130; June, 156; July, 140; August, 145; Total, 571. The total cost of hauling this (an average distance of about half

a mile), was $906.40, this item being included in the labor account as already noted.

Depreciation is an estimate, it being reckoned at 2 per cent per month of the original cost of the machines, this cost being for the electric machine $38,650, and for the steam machine $34,675. In Table II, showing costs at Germantown, the exact figure can be given, the work there being finished and the machine sold.

Tables I and III show the operating costs for May, June, July and August, 1921, severally, and for the four months period as a whole. The material moved during each month is also shown, and the cost per cubic yard for the excavation, including only the items as given in the tables. In Table I the cost per cubic yard is also given for the several items, for comparison with Table III, which exhibits the performance of the electric dragline machine at the Germantown dam. The yardage in each case is measured with the material in place in the dam embankment.

TABLE IV—CREWS FOR STEAM AND ELECTRIC DRAGLINES

Steam Machine	Rate of Pay	Electric Machine	Rate of Pay
Runner	$278 per mo.	Runner	$278 per mo.
Oiler	56 cts. per hr.	Oiler	54 cts. per hr.
Fireman	53½c. per hr.	Pit Boss	52c. per hr.
Pumpman	50 cts. per hr.	2 Laborers	40 cts. per hr.
Pit Boss	52½c. per hr.		
3 Laborers	40 cts. per hr.		

Examination of the figures will show that the cost per yard is least with the electric machine in every month of the trial. In only one month, June, did the steam machine approach its rival; in the others the advantage is decisive. For the whole period the cost per yard for the electric machine was 6.43c.; for the steam 7.53c. Except in June the yardage handled by the electric was the greater; and the total yardage it handled was greater in the ratio of 283,000 to 277,000.

It should be stated at once that the difference shown does not come from a difference in ability of the two operators. Both are first-class men, able to handle either an electric or a steam machine, and there is little to choose between them.

As to speed, *while in operation*, the steam machine seems to be somewhat the faster, due to its quicker swing and hoist, the loading being about the same in both. (But there seems to be no doubt that this difference can be corrected in a new gear ratio, or a slightly higher permitted speed, an absolute limit being set to this factor in the electric design.) But the superior speed of the steam machine while in operation is more than offset by the time lost in shutdowns for minor repair. Here the superiority of the electric is unquestionable, by emphatic testimony of electrical engineers and master mechanics alike. It is interesting to note, however, in this connection, that the supplies and minor repairs item in the cost accounts does not reflect this testimony, the total of this item being $1,993.24 for the electric as against $1,821.27 for the steam machine. Remembering that this item on the repair end is practically all spare parts, it would suggest that the manufacturer and not the contractor, is getting the chief benefit from this particular feature. In reduced labor cost for these repairs, the contractor would of course benefit.

As to cost of the energy, note that the "finished product" in electric current, is delivered to the machine on the dam at only slightly higher cost than the raw product, coal, is delivered into a pile at the edge of the borrow pit, the figures being $4,491.32 against $4,242.37 for the total period, the first moving 283,000 cu.yd. and the second 277,000 cu.yd. Note also that the excess cost of steam operation over electric lies largely in the labor of getting the raw energy, coal, handled by men and team across half a mile of borrow pit, onto the dragline, and into the boiler, the steam machine requiring for these purposes (and for water supply), three extra men on its crew besides the man and team that do the hauling. The remaining excess lies mainly no doubt in the crude mechanism of the dragline engine and boiler as a means of transforming the coal energy into mechanical energy at the drag cable, as compared with the high efficiency of the several transformations in the electrical system.

TABLE V—COST OF ELECTRIC ENERGY

Month	Max. Demand	Rate	Consumption	Cost
May	1,404 kw.	$0.0264	51,290 kw.-hr.	$968.83
June	1,440 "	0.0272	47,090 "	918.25
July	1,362 "	0.0253	69,600 "	1,259.96
August	1,404 "	0.0254	74,000 "	1,344.78

Two other points seem worth making. One concerns the apparently greater breakage of dragline cable on the electric machine, leading to a total expense of $1,685.35 for that time as against $844.49 for the steam. Opinions differ as to the reasons. The higher conservancy authorities consider this may represent normal conditions and attribute the result as perhaps due to a greater elasticity in operation of the steam machine, leading to lesser shock and lesser breakage to the cable. The mechanical and electrical authorities, however, believe the figures are due to a chance piling up of cable expense for the particular period, since such breakages occur at irregular intervals.

The other point concerns the relative costs at Germantown and Englewood, as given in Tables I and II. The materials at these two dams was much the same, except that the top soil at Germantown was somewhat thicker, and the underlying sand and gravel perhaps not quite so loose. But it needs emphasis again that the two tables are not directly comparable except as to current consumption. Supplies, minor repairs and drag cables, taken together, may perhaps also be compared, the figure being $0.013 per yard at Germantown, and $0.015 at Englewood. For the other items it must be kept in mind that the figures for Germantown are for the completed job, with equipment sold, while those at Englewood are running costs for the four months only, as heretofore noted. Labor at Germantown includes erection, dismantling, maintenance and operation, while at Englewood it includes only the two latter. Depreciation at Germantown is got by dividing first cost plus major repairs minus actual salvage value, by the total number of cubic yards placed in the dam. At Englewood it is an estimate only. The figures for Germantown give the actual cost per cubic yard for the several items; those for Englewood, necessarily incomplete, have their chief value as a basis of comparison.

Maximum Traffic Through Panama Canal

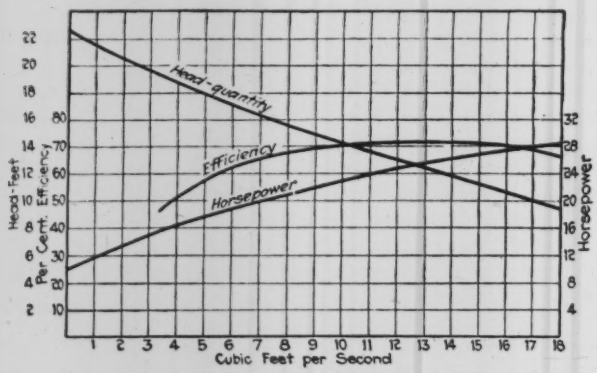
The high record of commercial traffic through the Panama Canal was reached Nov. 23, when 18 merchant vessels, the British cruiser Raleigh and a launch made the transit. The cargo carried was 78,648 tons, yielding nearly $80,000 revenue.

The New Orleans Automatic Sewage Pumping Stations

Trash Passing Pumps Simplify Maintenance and Attendance Saving City More Than $30,000 Annually in Salaries of Operators

By George G. Earl
General Superintendent, Sewerage and Water Board, New Orleans, La.

IN ABILITY to pass trash and still maintain a high efficiency the centrifugal pumps of the New Orleans Sewerage Commission, designed by its own engineers, have no equal. The successes of the early practice in eliminating the difficulties arising from trash have made possible the installation of a large number of automatic relifting stations requiring practically no attention. The saving in salaries over full-crew stations is in excess of $30,000 annually. The first of these pumps went into operation in 1917 and seventeen have been added since that time. So far they have "passed everything which has gotten around the suction elbow" and we see no reason to fear that they will ever fail to do so. Their efficiency is not in the least



EFFICIENCY TEST OF 12-IN. PUMP WHICH WILL PASS A 12-IN. BALL

interfered with by any amount of trash and we would not hesitate to build pumps of this latest type for the largest sizes and do away with all screening at the final discharge pumping stations.

The gradual development of the pumping of sewage at New Orleans leading up to the present types is interesting in many ways. In 1893 the writer, as engineer for the New Orleans Sewerage Co., took up the question of sewage pumping for the central section of the city, and could then find no one who would undertake the construction of a steam-driven centrifugal pump to discharge through 5,000 ft. of 36-in. force main against a varying lift of from 30 to 55 ft., including friction. In consequence a contract for direct-acting steam-driven pumps was let, but never executed because the company, after the construction of a few miles of sewers, was unable to finance itself further.

In 1900, when the city took up the sewerage problem for itself, contractors willingly competed on centrifugal pumps for this station and for two smaller stations discharging into the Mississippi River against similar lifts, and also for six automatically-operated intermediate-lift stations at which the lift ranged from 8 to 15 ft. The efficiency guarantees for these last-named stations were very low, and only 60 per cent pump efficiency was guaranteed at the high-lift stations discharging into the Mississippi River through long force mains. The specifications contained a requirement that all centrifugal pumps must be able to pass 3 x 4 in. spheroids, and while the contractors were able to make the larger steam-driven pumps at the central sewerage pumping station and the pumps at the intermediate-lift stations with low lifts comply with this clause, and to meet their efficiency guarantees, they could not accomplish this with the pumps of smaller capacity working at higher speeds at the other two stations, and discharging through long force mains against varying river heights. The claim was then advanced that the required ability to pass 3 x 4-in. spheroids made the guaranteed efficiency impossible to obtain for these last-named pumps, and pumps which made only 45 per cent efficiency were tendered for acceptance. The Sewerage and Water Board not being willing to concede so much, the contractors were requested to build runners after a plan furnished by the mechanical engineer of the board, which they did. It is said that the contractors' engineers did not believe that these runners would pump water at all, but they did. Further, they passed 3 x 4-in. spheroids, and made 80 per cent efficiency on test. These runners have been in constant service since 1908.

Vibrations Break Shafts

At the three stations discharging sewage into the Mississippi River, where coarse screens protect the pumps against trash, little trouble has been experienced. At the main sewerage station, however, with runners, just passing their efficiency guarantee, there was a certain amount of vibration which resulted eventually in the crystallization and breaking of the lower ends of vertical shafts of both pumps. As increased capacity had to be obtained, and the originally intended plan of adding another steam-driven pump and another 48-in. discharge main 7,000 ft. long to the river involved a cost which the board could not afford, especially since the higher rates of discharge would only be required for relatively short periods, it was decided to add a large electrically-driven two-speed centrifugal pump, working into the existing force main, instead of an additional steam-driven pump with an additional force main. This new pump was designed by A. B. Wood, mechanical engineer of the board, and was built by the Nordberg Manufacturing Co. without a guarantee of any kind. On tests, it showed as follows:

At low speed (248 r.p.m.) it discharged from 55 to 85 sec.-ft. against lifts of from 43 to 35 ft., with pump efficiencies from 69 to 83 per cent.

At high speed (364 r.p.m.) it discharged from 106 to 133 sec.-ft. against lifts of from 87 to 72 ft., with pump efficiencies of from 80 to 84 per cent.

This 36-in. pump has done practically all of the sewage pumping at the main station since 1915. It has had little difficulty in passing such trash as reaches it through the existing very coarse screens. It is a horizontal shaft outfit, driven by a 1,200-hp. induction motor operated by current from either of the board's power stations. With its installation the main sewerage pumping station changed from a steam-driven station

with a full crew to an electrically-operated station with a very small crew. Three-fourths of the boilers and much of the other equipment have been removed to the main power station, or to other points where they can be more usefully employed. The saving as a whole thus effected has been very great.

Rags the Great Obstruction

Six relifting stations, originally built to be operated electrically and automatically without screening and without attendance, started into operation in 1907. At first they gave no trouble and to this time their automatic stopping and starting, their ventilation, their atmospheric condition and dryness have been everything that could be desired. The one great difficulty which gradually became more and more serious was pump obstruction by rags accumulating on the runners. The capacity and efficiency was cut very seriously. More and more frequent visits and opening of pumps for the removal of rags became necessary. Two or three visits a day for their removal, and constantly reduced efficiency due to their presence, together with the nuisance which the accumulation of trash at the stations produced, seemed to indicate that screening and full provision for constant attendance with a screening's-removal service eventually would be necessary. Another factor which pointed in the same direction was that the main intercepting sewer, into which all sewers finally discharge, was built only large enough to take care of a certain portion of the area which they serve. It was the intention in the original plan to provide another interceptor in the future to carry the flow from the upper and rear portion of the city, but funds have never been available. The existing main sewer can take care of its dry-weather flow from the larger area for many years to come, but it is incapable of handling the flow which occurs during great storms, when the big masonry lined and covered drainage canals themselves are rivers of no small magnitude. To have built the necessary sewerage interceptors and main station pumping capacity and force mains to the river to handle this wet-weather sewage flow during great storms would have absorbed enough money to provide dry-weather flow facilities and satisfactory sewerage service for large areas requiring such service. It has been the policy of the board to give a reasonable service to the largest possible number of people all of the time, rather than to provide excessive safeguards and then give service as far as its funds would go to only a limited portion of the city. Under the above conditions, it appeared better to extend a full dry-weather flow sewerage service and let the storm drainage system take care of the excess sewage flow during great storms. To accomplish this result, provisions had to be made at the sewage relifting stations to send their discharge either into the discharge sewer or into the storm drainage system, a requirement which again pointed toward attendants at these stations.

Reasons for Automatic Stations

Six relifting stations existed in 1915, and two more were contemplated for early construction. Eventually, within the area served by the existing city drainage system, there will be at least twenty of them. The thought of adding attendants on three watches 365 days every year with a screenings-removal service for twenty scattered sewage pumping stations was enough to cause us to think again, at least.

The relifting pumps originally installed were only a trial installation, having usually only about one-third of the capacity of the suction sewer. Since the areas served were mostly outlying areas with many unpaved streets and in which local drainage conditions were by no means fully developed, the need for the full equipment of pumps was even greater after rains than it will be after the areas which they serve are fully built up, paved and provided with better local surface drainage facilities. It was therefore decided to provide pumping capacity fully equal to the maximum delivery capacity of the sewers on the suction side of these stations. Units having a capacity of about 15 sec.-ft., with 12-in. suctions and 12-in. discharge pipes, were decided upon. In view of our experience and our firm determination to continue the "automatic operation of these stations without screening and without attendants" we decided that the trash-passing specifications to which we could work should be 12-in. balls, instead of 3 x 4-in. spheroids, and to that we added table cloths, overcoats, assorted rags and trash, or anything else that could enter the pumps through their 12-in. suction elbows. We did not, however, send these specifications out for bids with guarantees attached, but instead had castings made according to our own designs and finished the pumps in the board shops. These pumps are single-suction centrifugal pumps with two-blade inclosed-type runners, which apparently pass anything which can enter the suction pipe. Results of a test are shown.

Mr. Wood has built these pumps up to 22-in. suction and discharge openings, and tested them out against heads up to 180 ft. While he has not obtained quite so high an efficiency with them as with the more usual type of centrifugal pump designed to work with water which is free of trash, he has obtained better than 70 per cent efficiency with a very flat efficiency curve over a wide range and with very desirable characteristics.

Function of Automatic Apparatus

The automatic apparatus at these stations covers a twofold function: First, it stops and starts the pumps. A heavy cast-iron float in a large float tube, which feels the pressure in the low-level sewer, starts the pumps one after another as the level in the sewer continues to rise and stops them one after another as this level continues to fall, each pump starting or stopping at different predetermined pressures in the sewer on the suction side. Second, it opens and closes the by-pass gates. Another apparatus feels the pressure in the discharge sewer and maintains a gate leading to the sewer open until this pressure rises to a predetermined amount, after which this gate is closed. Coincidentally another gate permitting the discharge from the station to enter the storm-water drainage system is opened, and remains open until the pressure in the discharge sewer falls to another and very much lower predetermined pressure, when the first-named condition is restored.

Nothing inside or outside of any of these sewage relifting stations indicates to sight or smell that they are sewage pumping stations. Most of them are entirely beneath the street surface with only a very small structure usually built along the curb line, to carry a circular stairway to permit entrance. The eighth of these stations is now in course of construction, and at least one other will have to be built in the early future.

We regard their success and the practicability and desirability of the automatic operation of electrically-

driven centrifugal pumps for sewage pumping without screening and without attendants, for a wide range of lifts, or conditions, as fully demonstrated. Since 1907 these stations have been operated with never more than two men taking care of six widely scattered stations, and never more than three visits a day to any station. We still continue one visit a day to each station, but one visit every 15 days would do as well as matters now stand.

Extensive Surface Repairs to a Concrete Dry Dock

Gunite on Wire Mesh Forms Continuous Sheet Over Sides and Floor—Six Cement Guns Did the Work in 50 Days

REPAIR of a concrete graving dock at South Chicago, Ill., made necessary by disintegrated concrete, has been effected recently by covering the surface with gunite applied over a layer of wire mesh by means of the cement-gun. Fig. 1 shows the application of the gunite to the floor, with a portion of the completed wall at the right.

This dry dock, at 101st St. and the Calumet River, is owned by the Chicago Shipbuilding Co. and was built in 1915. It is 705 ft. long, 88 ft. wide on the bottom, 106 ft. wide at the top and 29 ft. deep. Owing to disintegration of the surface, it was decided during the summer of 1921 to carry out repairs and prevent further deterioration. As a rule the disintegration does not go very deep, but in some places deep holes could be made easily.

In the repair work, the entire surface of the walls and floor was gone over thoroughly with ordinary picks where the concrete was soft, and in some cases it could be removed in large slabs and flakes. This first cleaning was followed up with pneumatic chipping hammers by means of which the entire surface was thoroughly

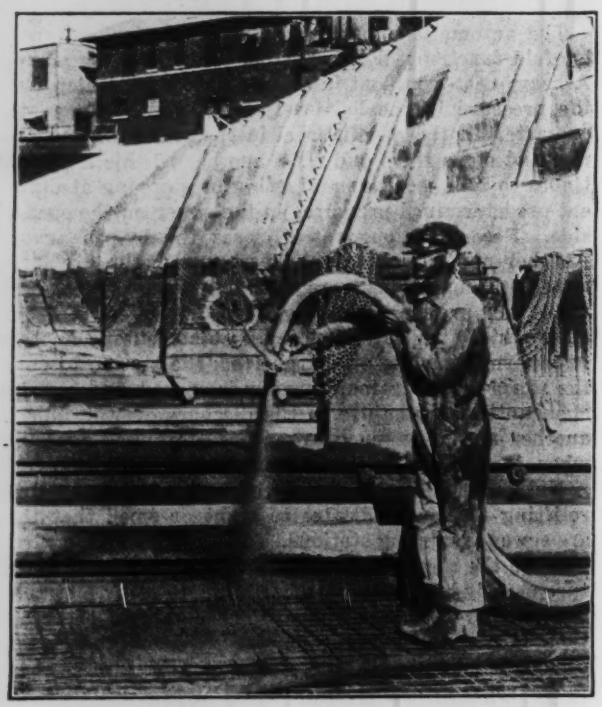


FIG. 1. APPLYING GUNITE SURFACE TO FLOOR OF DRY DOCK

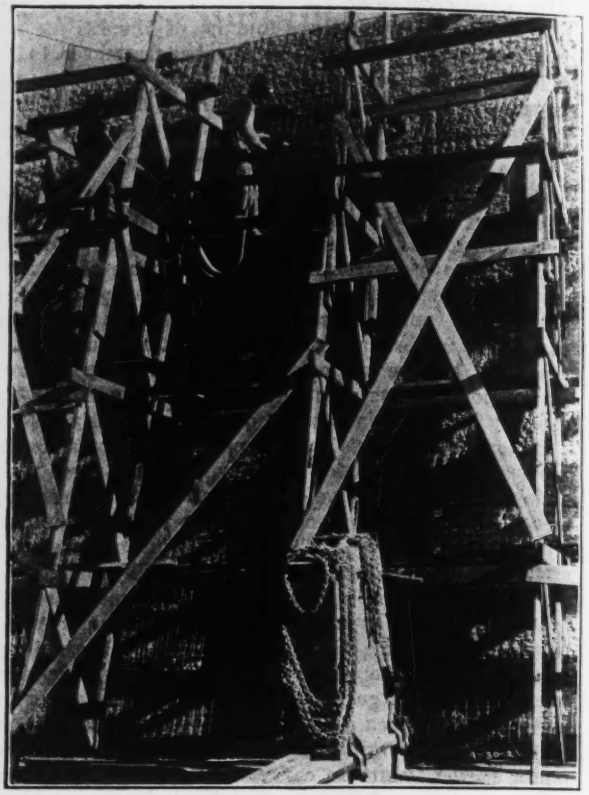


FIG. 2. SCAFFOLDS AND REINFORCEMENT FOR CEMENT-GUN WORK

cleaned where the concrete was soft and scored where the concrete was sound. Holes 1¼ in. in diameter, about 6 in. deep and spaced approximately 30 in. c. to c., were drilled all over the walls and floor with pneumatic drills. Railroad spikes were set in the holes and secured by grouting. To these spikes horizontal steel rods were secured, and to the rods was fastened heavy steel wire mesh reinforcement. This wire mesh extended over the top of the wall and about a foot down on the outside.

Gunite was then shot in place, to form a heavily reinforced coating, beginning 1 ft. down on the outside of the wall, extending over the top, down the wall and across the floor in one continuous sheet. Fig. 2 shows the scaffolding, reinforcing rods and wire mesh, and also the gunite being applied by the men at the right.

About 400 lin.ft. of the dry dock was scaffolded at one time, the scaffold being taken down and moved as the work proceeded. A locomotive crane on the surface was used for this work. The scaffold was made in 6-ft. sections which were made up complete on the surface, the locomotive crane carrying them to place and lowering them into position. The 6-ft. sections of scaffold were placed 6 ft. apart, so that the operating plank would span from section to section, and the sections were lightly tied together with horizontal stringers consisting of 1-in. boards.

As it was desired to push the work vigorously and so far as possible prevent the loss of work in case of rain, the scaffold was so built that tarpaulins could be thrown over the top and extend down the sides to protect the new material against the washing action of the rain. Thus work could be carried on until the rain became

so heavy as to drive away the men. In this way very little time was lost.

Two batch mixers were used, both specially adjusted for the semi-dry mix used in cement-gun work. These were placed on the top of the wall. After screening, the mix was delivered by means of chutes to two platforms on the floor of the dock, around each of which three cement guns were grouped. In this way, six cement guns were used continuously. The contract for the repairs was taken by the Cement Gun Construction Co., Chicago. Work was started Aug. 29, 1921, and was pushed vigorously with a large force of men and equipment so that it was completed in about 50 days.

France Builds Compressed Straw Houses

A NEW system of building houses now in vogue in various parts of France utilizes as a principal material straw pressed and molded in blocks of convenient dimensions, says a recent issue of *Le Genie Civil*. Straw has long been used in construction, though principally in roofing, but the Feuillette system (named after its originator) produces houses of one or two stories which are quite as weather-resisting, says *Le Genie Civil*, as those constructed of masonry.

The framing of the houses is of light wood and usually is put up in sections, so that fabrication on a wholesale scale is possible. The blocks of compressed straw are merely used as filling for walls and partitions, all the stresses being carried by the framing. The blocks are made usually 40 cm. in thickness and of a length depending upon the dimensions and spacing of the framing members. The blocks are made by subjecting the straw to intense pressure in a press similar to those used for compressing fodder.

The main characteristic of the straw houses is their lightness of construction—the weight of all materials is put at one-sixth of that of an ordinary masonry house of the same dimensions. Accordingly it is possible to put in foundations much less massive than would otherwise be used. Then straw is a poor conductor of heat, a fact which keeps the house cool in summer and makes it possible to heat it easily in winter.

In order to keep the dampness from mounting from the foundations up through the walls there is placed between the foundations and the first course of straw bricks layers of bitumenized cardboard.

The exterior walls are smeared with some waterproofing mixture which, it is said, render the houses almost as impervious to moisture as any other type of construction. On the interior walls is placed a waterproofing mixture of a lighter grade and to this adheres the wallpaper, tinting or whatever other decorative materials are used.

The roof is of ordinary construction and the windows and doors are placed upon special sills of a cement mixture to guard against the infiltration of rain water or that from the melting of snow or ice. Lightness of the materials of which the houses are constructed allows rapid construction of them. It takes from one to two months to complete a house, and the economy of time and materials over the ordinary type of masonry construction in wide use in France is estimated at 40 per cent, by the originator of the system. This saving would perhaps be greater, it is pointed out, in agricultural or industrial construction, where masonry is always the most expensive construction item.

If let alone the straw would serve as refuge for insects and vermin of various kinds but this has been guarded against by putting around the perimeter of the house, between the foundation and the first course of bricks, a perforated pipe through which, from time to time, may be passed toxic gases—for example sulphuric gases and formic aldehyde—which spread throughout the thickness and the height of the straw brick walls. Thus is supplied a permanent system of disinfection. Houses already built in various parts of France have been as free from vermin as masonry types.

The risk from fire seems not to have been raised above that of the ordinary type of building, for the insurance companies have applied the same rates to the straw houses that exist for the other types.

"The construction of this style of house—light, sound resisting, isothermic—seems destined to have great use in agricultural communities where the usual materials are rare," says *Le Genie Civil*. "They will be able, without doubt, to render service in devastated regions where they should permit rapid reconstruction work.

"Finally, for countries or communities subject to earthquake shocks the straw house is interesting, because of its lightness and its small amount of inertia. Its framing, relatively elastic, should easily permit it to withstand seismic disturbances.

Suggestions for Electrolysis Mitigation

A VOLUMINOUS second report has been issued by the American Committee on Electrolysis, a joint committee of nine electrical, gas, and water associations. The preliminary report of this committee, issued in 1916, is intended to be superseded by the new report, although more work is to be done and further reports may be expected. The great value of the present report is that it represents unanimous agreement of the representatives of all the organizations involved on some fundamental points, including, perhaps as the most important, suggestions for the mitigation of electrolysis trouble.

Stating that the practical electrolysis problem is due to electric-railway stray current, the committee lists suggestion of two kinds, those which reduce stray current by more efficient and economical operation of the railway (better bonding and more complete distribution of current supply), and those tending to prevent or limit electrolysis effects when stray current exists. The latter include the insulation of joints in pipes and cables, the provision of insulated coverings for pipes, and, as measures of opposite kind, the interconnection of affected structures with the railway return circuit and electrical drainage of pipe and cable sheaths. They also include the provision of substations and return feeders in an amount exceeding the requirement of most economical railway operation, and the use of a modified system of power distribution.

Reviewing results attained in this field abroad, the committee reports that electrolysis trouble has been largely eliminated in Europe. Further research, necessary to develop American practice fully, should include the study of current densities across contact surfaces of pipes and earth, and study of the actual efficiency of various methods of electrolysis mitigation. The committee, which is headed by Bion J. Arnold, 33 W. 39th St., New York City, is issuing the report for a nominal price of $1, although the major publication cost has been defrayed by the societies joined in the work.

English Impact Measurements Analyzed

Significance of the Results and Comparison with A. R. E. A. Tests—Deficiency of Observed Live-Load Stresses—Influence of Secondary Stresses—Impact on Short Spans—More Tests Needed

By F. E. Turneaure
Dean, College of Mechanics and Engineering, University of Wisconsin, Madison

THE English impact tests reported in *Engineering News-Record* of Oct. 20, p. 642, are highly interesting, not only because of their results but also because of the use of a form of extensometer which records by mirror and photographic film. This apparatus has undoubtedly considerable advantage over the form of apparatus used in the American Railway Engineering Association tests, by reason of the very small inertia effected and the high frequency of the vibration period of the instrument. This instrument should enable tests to be made on very short spans in a more satisfactory manner than we were able to accomplish with the American Railway Engineering Association instruments, in which the frequency is relatively low, resulting in many cases in disturbing instrumental vibrations.

Outside of the effect of instrumental vibration, the results obtained in the English tests show the same general characteristics as those obtained in the American Railway Engineering Association tests, and the diagram of maximum values (p. 644) corresponds as well as could be expected to the results obtained in the American tests. Anyone who has carried on experiments of this kind appreciates very fully the fact that results are not altogether consistent, and that some erratic values must be expected, due in part to the variety of causes producing impact and in part to the effect of secondary stresses, inaccuracy of instrument, and other causes not easily determined.

Measured Stresses Too Low

In examining the published results on page 643, a very noteworthy feature is the large discrepancy existing in most cases between the calculated live-load stress and the observed live-load stress at slow speeds, or the so-called observed static stress. This discrepancy is so large as to have a considerable bearing on the significance of the impact percentages as calculated in column 15 of the table. Generally speaking, the higher values of impact percentage occur with very low ratios of observed to calculated live-load stress; and on the other hand, where the ratio of observed to calculated live-load stress is relatively high, the impact percentage is generally low.

Considering the 19 reported measurements on plate-girder flanges, the three highest values of impact percentage are 77.5, 80, and 92 (neglecting the plus-or-minus errors); the corresponding ratios of observed to calculated live-load stress are 50, 27, and 43 per cent. The highest ratios of observed to calculated live-load stress are 92 and 94 per cent, and the corresponding impact percentages are 30 and 26. In the 10 measurements on lower-chord members, the maximum impact percentage is 62, with a ratio of observed to calculated live-load stress of 35 per cent. The maximum ratio of observed to calculated live-load stress is 85 per cent, with an impact ratio of 13 per cent. The average ratio of observed to calculated live-load stress for all lower-chord tests is 48 per cent. Three high values of impact percentage on rail bearers are: 159 per cent, with a ratio of observed to calculated live-load stress of 53 per cent; 93 per cent with a live-load ratio of 30 per cent; and 76 per cent with a live-load ratio of 10 per cent. The only high impact coincident with high ratio of observed to calculated stress for rail bearers is 90 per cent impact for a live-load stress ratio of 100 per cent.

Two questions arise in considering the significance of these results: First, the cause of the low ratio of observed to calculated live-load stress; and, second, the effect of this condition upon the impact percentage, and upon the selection of the proper formula to use in designing.

Influence of Secondary Stresses

The very low ratios of observed to calculated live-load stress are due to various causes, some of which, at least, have been mentioned in the article in question, namely, effect of deduction of rivet holes and omission of web in calculating flange stresses, effect of floor system in carrying load, and effect of secondary stress. In the case of the measurements on lower chords the effect of the floor system could not be of much consequence, and the discrepancy must be attributed almost wholly to the effect of rivet holes and to secondary stresses, as the actual total stress in such case must be very closely equal to the calculated stress. The very low average ratio of observed to calculated stress in these members (namely 48 per cent) indicates that secondary stress must be a large factor in reducing the observed stress. Without more detailed knowledge of the exact position of the instrument and make-up of the members themselves, it is impossible to extend a study of this phase of the question much further; but it is, I think, desirable to point out the possible effects of secondary stress on the determination of the impact values.

Abnormally High Impact

The experience of the committee of the American Railway Engineering Association in conducting its tests shows that, where the secondary stresses were opposed in sign to the other stresses, their effect was generally to increase very considerably the impact percentage as calculated by comparing maximum readings with slow-speed readings. In many cases two and sometimes four instruments were used on the same member, so as to determine approximately the actual secondary stresses as well as the impact ratios. In a built-up lower-chord member, for example, there would be very considerable secondary stresses near the joints and the instrument on the upper edge might show a slow-speed or static stress much less than the intrument on the lower edge. The effect of vibrations under high-speed tests would frequently affect the upper instrument as much as the lower, which would result in the calculated impact percentage for the upper edge being greater than the lower. The actual maximum fiber stress, however, would occur on the lower fiber, and the impact percentage for this

side would be more significant than the impact percentage for the upper fiber. Furthermore, on account of this bending effect, the deformations recorded by the instrument do not represent the actual deformations of the extreme fiber. since the instrument measures the deformation not of the extreme fiber of a member but of an imaginary fiber at a considerable distance from the surface of the member. In the instruments used by the American Railway Engineering Association, this distance was 1½ inches.

Similar Effects in A.R.E.A. Tests

As an illustration of this bending effect, taken from the results of the American Railway Engineering Association tests, I give below the impact percentages calculated for the two sides of the bottom flange of a 70-ft. plate-girder span. The static stress on the outside flange was 2,200 lb. per sq.in.., while on the inside flange it was 2,900. The impact percentage on the outside flange was 78 per cent and on the inside 64 per cent. Obviously, the 64 per cent is more significant than the 78 per cent. In another case, two instruments were attached to one of the vertical posts near the center of a 300-ft. span truss. The total stress was not large but there was considerable secondary stress due to lateral and floor-beam action. This resulted in a static tensile stress of 1,100 lb. per sq.in. on one corner of the member and a compressive stress of about the same amount on the other corner. Under high speed, the vibrations of the truss produced an impact of 89 per cent on the tension side. Under the circumstances, this result would seem to be of very little significance.

In another structure, consisting of a 64-ft. riveted truss, four instruments were placed on the four corners of a lower chord member. The separate results were approximately as follows:

	Slow-Speed or Static Stress, Lb./Sq.In.	High-Speed Max. Stress, Lb./Sq.In.	Impact, per Cent
Inside top edge	840	2,150	156
Inside bottom edge	3,800	5,400	42
Outside top edge	3,600	5,400	50
Outside bottom edge	6,700	8,600	28

There was evidently considerable lateral as well as vertical bending due to large secondary stresses. The axial stress found by averaging diagonally opposite edges is practically the same from both sets of diagonals, thus indicating consistent results and roughly checking the behavior of the instruments. It will be noted that the absolute effect of the vibration due to high speed is not much greater on the highest stressed corner than on the lowest stressed corner, but the impact percentage is widely different. In this case the value of 156 per cent is obviously of little significance in selecting a proper impact ratio for design purposes. The committee used a value for this truss of about 50 per cent. This was an extreme case of bending stresses, but it illustrates the difficulty of arriving at a proper impact percentage from measurement on one edge of a member only, and also the general principle that where there are secondary stresses the measurements taken on the edge of the member having the lesser stress will almost certainly show the higher impact values.

This effect of secondary stress was so noticeable in the tests conducted by the American Railway Engineering Association Committee that a considerable effort was made, especially in the case of eyebars, to place the instruments at approximately the quarter-points of the members, as the effect of secondary stresses due to member vibration is approximately a minimum at this point. This is quite evident when we consider that vibrating members, even eyebars, will act as beams fixed at the ends. The A.R.E.A. committee had at its disposal 12 instruments, and in the case of riveted members and plate girders usually placed instruments on at least two edges of the member, sometimes on four corners. In this way some check was had on the effect of secondary stresses, and where impact values were calculated for two sides of the same member the practice of the committee in general was to adopt an average value of maximum impact percentage obtained from the separate readings, as the most significant value for the member in question. It would seem to be on the safe side.

Impact on Short Spans

Considering further the actual values obtained in these English tests, there would appear to be some good evidence indicating an impact greater than 100 per cent for very short spans, although the tests are not very conclusive on this point, especially when viewed in the light of the above discussion. The A.R.E.A. committee obtained a few values greater than 100 per cent, and expressed its belief that probably accurate tests of very short spans would show an impact ratio of somewhat more than 100 per cent. The proposed curves in the diagram of the English tests give impact values exceeding 100 per cent for spans below 25 ft., apparently based on these particular tests.

This question was carefully considered by the A.R.E.A. committee, both by the subcommittee and by the full Committee on Iron and Steel Structures; and while it was recognized that probably the impact for very short spans might occasionally be more than 100 per cent, a value of 100 per cent at zero span length, with a curve of the form adopted, was considered satisfactory. The only structures appreciably affected by a higher curve would be spans less than 20 ft., that is to say plate girders and I-beams. For this type of structure, used generally for spans up to 75 ft. or more, it appeared to the committee that past experience should be given very considerable weight. Considering the use of the vast number of structures of this type designed on the basis of approximately 100 per cent impact and overloaded in many cases to the extent permitted by the A.R.E.A. rules for rating existing structures, it was concluded by the committee that 100 per cent was sufficiently high. The plate-girder type of structure is less affected by secondary stresses and local vibrations than are trusses, and for this and other reasons might reasonably be designed on a basis of a somewhat higher working stress than trusses. This possibility has been suggested several times, but it was considered by the committee preferable to maintain the same working stress as for trusses and substantially the same impact for short spans as has been used for many years, namely, 100 per cent at zero span length. This is perhaps not a strictly logical method of procedure, but it has the advantage of simplicity, and was adopted for the reasons given.

Precision and Range of Tests

Referring again to the tabulated results, it would seem that the precision of the readings is not quite as great as would be indicated by the tabulated figures. As stated in the article, the readings were made by dividers and an ivory scale, checking to 0.005 in. They

are, however, recorded in the table to the nearest one-thousandth inch, this being obtained probably by averaging. It is hardly to be expected that readings of the kind can be determined to an accuracy of 0.001 in. The American Railway Engineering Association committee did not go beyond 0.01 in., but photographic records could probably be measured somewhat more accurately than the pencil records of the American Railway Engineering Association tests. However, the shifting of the zero line in many cases, indicated by the plus-or-minus errors, seems to indicate that in spite of the sensitiveness of the apparatus its precision is hardly enough to warrant reading the records much closer than 0.01 in.

This is of some significance in connection with some of the smaller values, such as the one where the low-speed stress is given at 0.17 and the high-speed stress at 0.30 tons per square inch. The actual ordinate measured in the first case was 0.017 in. and in the second case was 0.03 in., and from these figures the impact percentage was calculated as 76 per cent. If I am correct in my understanding of the scale used in these readings, it would seem difficult to establish an impact percentage more accurately than 50 to 150 per cent. In other words, this particular reading is not of much value.

In these comments, I do not wish to be considered as criticising the work of the English committee. Its results are of much value, and I feel very confident that the instrument used is more sentitive and accurate than that used by the American Railway Engineering Association committee for short span tests. It is to be hoped that many further tests will be made. The tests reported do not go beyond a span length of 146 ft. 8 in. They therefore do not give any additional information concerning impact on long spans. For the range tested it would appear that these tests when viewed in the light of the above discussions give results somewhat lower than those obtained by the A.R.E.A. committee.

Major Mount's definition of impact as "the effect produced upon any member of a structure by a moving load which results in stress exceeding the static stress" is substantially the same as that given in the first report of the A.R.E.A. committee, namely, "The term impact is here used to include any effect of the moving load which results in stresses exceeding the static stresses." This is the sense in which the matter has been considered in all the work of the committee.

New National Forest in Pennsylvania

The Allegheny National Forest is to be created on the headwaters of the Allegheny River in Pennsylvania, according to an announcement of the United States Forest Service. The land which it is proposed to acquire consists of some 400,000 acres in Warren, McKean, Forest and Elk Counties, this area having been selected by the National Forest Reservation Commission and approved by the State of Pennsylvania. It is expected that at least 50,000 acres will be acquired during the current year, but additional purchases will depend on an appropriation for next year, for which no provision has been made by Congress. There have previously been acquired some 2,000,000 acres in 17 sections of the White Mountains and Southern Appalachians. The federal legislation under which these purchases are made is designed to aid in the regulation of navigable streams.

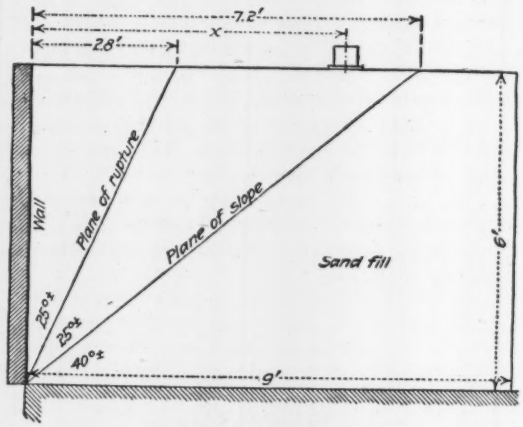
Measured Retaining-Wall Pressure From Sand and Surcharge

Cincinnati Experiments on Effect of Settling, Static and Dynamic Surcharge—Full Wall Friction Active

By Jacob Feld
Research Fellow, University of Cincinnati

EXPERIMENTS conducted at the University of Cincinnati during the past two years have shown the adaptability of the earth-pressure test bin described in *Engineering News-Record* of Aug. 25, p. 314, for investigations of the action of granular materials subjected to various external influences. Recent measurements of the variations in the lateral pressure exerted by fills of sand can now be reported. The maximum height of fill was 6 ft. Static and dynamic surcharges were tried, and the results therefore are directly applicable to railroad fills retained by walls, as well as to ordinary retained fills.

The apparatus measures the horizontal and vertical components of pressure due to granular material in a



SECTION OF TEST-BIN

large concrete bin (12 x 5 x 12 ft.) against one side, which is a "free" wooden wall 5 ft. wide by 6 ft. high. The material used was a river sand, containing 8% gravel, 3% clay, 6% water and practically no loam. It weighed 100 lb. per cu.ft, and when shovelled assumed a natural slope of 40 deg. The coefficient of internal friction as determined by experiment was 0.67 when using the force required to keep the sand in motion, and 0.75 when using the force required to start motion, corresponding to angles of friction of 34 and 37 deg. respectively. These coefficients were determined by filling with sand a bottomless box which rested on a surface of the same sand, and measuring the force required to start motion and to keep up the motion uniformly. If we assume that the difference between the two values found is due to cohesion (which does not act during motion) then 0.67 and 0.75 are the coefficients of internal resistance to motion, the first due to friction alone, the second due to the combined effect of friction and cohesion.

Level Fill.—Tests with sand containing different percentages of water and therefore giving different coefficients of internal friction and densities, using test-walls backed with wood, glass and sheet metal, yielded the

following formulas for the pressures of horizontal fill against a vertical wall:

Horizontal component, $H = \frac{1}{2} wh^2 \tan \frac{1}{2} (90° - \phi)$

Vertical component, $V = H \tan \phi'$

Total pressure $P = \sqrt{H^2 + V^2}$

The horizontal component is very closely given by the formula deduced by Coulomb (1773), which formula also represents a special case of the Rankine theory. But while both theories assume ϕ to be the angle of natural slope, the present formula requires ϕ to be the angle of internal friction corresponding to the force required to *start* motion. For sand its value is approximately equal to 0.9 of the angle of natural slope. The vertical component in all cases is found to be equal to the product of horizontal component and coefficient of friction between wall and filling material. In other words, the lateral earth pressure acts at an angle ϕ' to the horizontal (for vertical wall). The value of ϕ' was found in the same manner as the coefficient of internal friction. The height of application of the resultant is about $\frac{1}{3}h$ for fills up to 2 ft. deep. For deeper fills the resultant rises to from $0.34h$ to $0.37h$ under ordinary conditions.

TABLE I. PRESSURE OF 6-FT. LEVEL SAND FILL
(Pressures in Lb. per Ft. Width of Wall)

Day	Time	Time of Settling, Hr.	Temp., Deg. C.	Horiz. Comp.	Vert. Comp.	Total Press.	Ratio V/H	Ratio Height Above Base
1st	5 p.m.	0	13	456	z299	545	0.66	0.335
2nd	12 m.	19	14	x419	286	x508	0.68	0.34
2nd	5 p.m.	24	13	422	286	509	0.68	0.34
3rd	9 a.m.	40	19	426	280	510	0.66	0.34
3rd	12 m.	43	20	432	284	517	0.66	0.34
3rd	5 p.m.	48	20	432	286	518	0.66	0.34
4th	12 m	67	17	451	279	530	0.62	0.34
5th	9 a.m.	88	14	463	x278	540	0.60	0.345
5th	10 a.m.	89	16	466	278	542	0.60	0.345
5th	12 m.	91	17	469	280	545	0.60	0.35
5th	5 p.m.	96	17	467	283	546	0.61	0.35
6th	9 a.m.	112	15	461	281	540	0.61	0.35
6th	11 a.m.	114	19	x473	286	x 553	0.605	0.35
6th	12 m.	115	19	472	286	552	0.605	0.35
6th	5 p.m.	120	18	465	292	549	0.63	0.35
7th	9 a.m.	136	17	449	287	534	0.64	0.345
7th	12 m.	139	21	453	290	537	0.645	0.35
7th	5 p.m.	144	20	454	293	541	0.645	0.345
8 h	9 a.m	160	19	444	292	531	0.66	0.34
8 h	12 m.	163	23	448	291	534	0.65	0.34
8 h	3 p.m.	166	26	469	290	552	0.62	0.34
Per cent variation from initial reading:				+3.7 —8.0	+0.0 — 7.0	+ 1.6 — 6.8	+ 3.3 — 9.7	+ 5.0 — 0.0

NOTE: x, denotes minimum reading. z. denotes maximum reading.

To determine the effect of settling and variation in temperature upon these three factors in the determination of the earth pressure, readings were taken for a period of 8 days of the pressure of a 6-ft. fill. Various other tests on smaller heights check the results obtained. Table I gives a few of the readings obtained. A "blank test," where readings were caused by a mechanically applied pressure against the wall, showed very little variation, thereby proving that the variations in the values of Table I are due to changes in the fill and not to changes in the apparatus.

Conclusions for Level Fill.—The initial pressure is practically the maximum. The minimum pressure occurs within one day after filling. Both components vary directly with the temperature, i.e., a rising temperature is accompanied by an increase in pressure, and a falling temperature by a decrease; the variation being about 0.15% per degree Centigrade. Settling of the fill causes a slow decrease in both components, with intermittent sudden increases, especially of the horizontal component, due to small ruptures in the fill. But the total pressure does not appreciably surpass the original value. The point of application of the resultant rises very slowly with time, and the ordinarily used value $h/3$ is always on the safe side. The ratio of vertical to horizontal component, or the tangent of the angle of inclination of the resultant earth pressure, remains fairly constant and equals the coefficient of friction between the fill and the wall.

TABLE II. PRESSURE OF 6-FT. FILL WITH 100-LB. SURCHARGE AT VARIOUS DISTANCES FROM WALL
(Pressures in Lb. per Ft. Width of Wall)

Distance Load from Wall x, Ft.	In.	Horiz. Comp.	Vert. Comp.	Total Press.	Ratio V/H	Ratio Height Above Base	Increase in P
(No Load)		[469.2]	[286.8]	[551.6]	[0.610]	[0.367]	
8	6	472.5	288.6	553.6	0.610	0.367	0.4%
7	6	473.4	288.9	554.6	0.611	0.367	0.5%
6	6	474.4	289.4	555.8	0.611	0.367	0.8%
5	6	475.3	290.0	556.8	0.611	0.368	0.9%
4	6	476.3	290.5	557.9	0.611	0.367	1.1%
3	6	478.1	291.7	560.1	0.611	0.368	1.5%
2	6	479.7	293.8	562.7	0.612	0.368	2.0%
1	6	483.1	297.5	567.6	0.617	0.380	2.9%
[After Test, no Load]		[483.5]	[299.3]	[568.6]	[0.620]	[0.380]	[3.1%]

Static Surcharge.—The horizontal section of the bin is 5 x 9 ft.; 45 pieces of 1-in. board, 11¾ x 11¾ in., were used to cover the surface of a 6-ft. level fill of sand. A single load of 100 lb. was successively placed on each square, starting with the one farthest from the wall, and readings taken while the load rested on the fill and after it had been removed; the effect was that of a localized surcharge of 100 lb. The averages of the five positions of the load at each distance back of the wall gave the values in Table II.

Conclusions for Static Surcharge.—An approaching load produces an appreciable increase in pressure when the load is still about 2 ft. away from the intersection of the plane of natural *slope* with the surface. The rate of increase is about constant until the load reaches a point midway between the planes of rupture and natural slope; much faster increase follows, as the load moves closer to the wall. The ratio of vertical to horizontal component is constant till the load is on the wedge of rupture, when it increases slightly. The changes in magnitude, direction and position of the point of application remain undiminished after the load is removed, showing that such changes are due to changes in the physical properties of the fill. Both the density and the angle of repose are increased.

TABLE III. PRESSURE OF 6-FT. FILL AFTER ROLLING 100-LB. LOAD AT VARIOUS DISTANCES FROM WALL
(Pressures in Lb. per Ft. Width of Wall)

Distance Load from Wall, x, Ft.	In.	Horiz. Comp.	Vert. Comp.	Total Press.	Ratio V/H	Ratio Height Above Base	Increase in P
Initial		483.6	299.4	568.6	0.620	0.369	0.0
8	6	484.4	299.8	569.6	0.620	0.368	0.2
7	6	484.6	300.0	570.0	0.619	0.368	0.2
6	6	484.6	300.1	570.0	0.620	0.368	0.2
5	6	485.0	300.1	570.4	0.619	0.369	0.3
4	6	485.4	300.4	570.8	0.619	0.369	0.4
3	6	485.8	300.6	571.2	0.619	0.369	0.5
2	6	485.9	300.9	571.4	0.619	0.369	0.5
1	6	486.6	301.6	572.4	0.619	0.370	0.7
Allowed to stand for 7 days.							
Maximum (96 hrs.)		499.0	287.0	575.6	0.575	0.384	+1.1%
Minimum (118 hrs.)		464.8	268.2	537.0	0.577	0.392	—5.4%

Dynamic Surcharge.—The same fill was then subjected to moving load by rolling a 100-lb. keg of nails across the bin, at a speed of about 3 ft. per sec. Readings were taken after rolling the weight three times across the width of the bin and removing the weight.

The variations obtained, Table III, are due to a passing load at various distances from the wall and *not including the load itself*. Eight distances, spaced 1 ft. apart, were included in this test.

Conclusions for Dynamic Surcharge.—Rolling a fill after tamping has no immediate effect on the pressure. Settling after rolling and tamping resulted in a slight increase in pressure and a rise of the point of application, due to some rupture in the fill, later followed by a gradual return to the original pressure, the point of application remaining at its highest point. The decrease in vertical component is due to a drying out of the fill along the wall surface.

General Deductions.—These tests show that although the pressure of sand against a retaining wall is closely approximated by the theoretical formulas, the idea of a wedge of rupture is not exactly correct, for loads outside the plane of rupture have an appreciable effect. The fill does not transmit pressures immediately but undergoes a temporary set upon the application of loads, and retains this set after the removal of the loads. It therefore does not act as an elastic solid.

The apparatus used was designed and constructed by the writer under the advisorship of G. M. Braune, late Professor of Civil Engineering at the University of Cincinnati. Some of the tests were performed last year, the rest, under the advisorship of E. D. Gilman, Assistant Professor of Civil Engineering, during the past few months. Investigations are now being made into the influence of non-horizontal surfaces and non-vertical walls.

English Experiments on Sand Pressure

(*London Correspondence*)

P. M. CROSTHWAITE has recently given particulars to the Institution of Civil Engineers of some experiments on the pressure of sand. To ascertain the angle of internal friction in sand, clay and other materials, he loaded a plunger of known diameter and measured the penetration (d, in feet) caused by known weights P. The value of ϕ, the internal angle of friction, was calculated from Rankine's formula

$$d = \frac{P}{w}\left(\frac{1-\sin\phi}{1+\sin\phi}\right)^2$$

where w is the unit weight of the material. The angle of friction from these experiments was much less than the angle of repose, and depended on whether the material was put loosely together, shaken or consolidated.

To test his conclusion that walls calculated by Rankine's theory, which assumes the angle of internal friction and the angle of repose to be the same, would have a factor of safety of from 2½ to 4, he then measured the pressure of dried sand against a model wall. The first experiments were made with a vertical door backed with sand and hinged at its lower edge, the tension in a string necessary to keep it in position being measured. Experiments were made with level fill and surcharge, and with loose and stirred sand. They proved that the pressures calculated by Rankine and Coulomb are much too high.

To test the wedge theory, a false bottom coated with glued-on sand was provided that could be set at any angle with the back of the wall, so that the pressure produced by any wedge could be measured. These experiments proved that the wedge theories of Darwin, Boussinesq, Brightmore and others that take into account the friction between the back of the wall and its backing give correct results for the wedge of maximum thrust so long as the wall is not surcharged, but that they break down altogether when applied to a surcharged wall, the calculated pressures being 30 per cent too great; also, that wedges making a small angle with the back of the wall produce a greater pressure than calculation by the theory gives. However, when the formula was modified by neglecting the friction against the back of the wall and using the angle of internal friction instead of the angle of repose, the results agreed with the test values. The angle of internal friction was in this case arrived at by calculating what angle would satisfy the maximum pressures observed for the unsurcharged wall for the sand lightly put together and well stirred. These angles, instead of being 35°, the angle of repose, were 42° 20′ and 49°.

Mr. Crosthwaite then experimented to test definitely if wall friction did actually affect the horizontal pressure or not. A long box was cut into two compartments by a vertical transverse saw cut. One half was fixed to solid supports, the other being carried on live rollers. When the box is full of sand the two compartments are urged asunder by the pressure of the sand on the plane passing through the saw cuts, which pressure was determined by measuring the tension on a string that prevented the rolling half of the box from being pushed forward. The rolling box was then turned end for end, so that the sand in the fixed compartment was held in position by the solid end of the box, the face of which was coated with glued-on sand. This is the same as if it had been retained by a rough wall, and if friction between the wall and backing affects the amount of the horizontal thrust the amount of the tension required to keep the rolling box in position should have been less than before. There was practically no difference, which showed that it is not correct to assume that friction between wall and backing affects the horizontal thrust.

The conclusions are that the plane of rupture has no existence, at least no trace was found of it in these experiments; that the angle of repose relates only to the surface; that the angle of internal friction varies with the state of aggregation of the material; that friction at the back of wall does not affect the amount of the resultant thrust; that the wedge theory when modified by leaving out wall friction and introducing, instead of the angle of repose, the angle of internal friction, gives correct results in all cases.

Status of Federal-Aid Road Projects

The status of federal-aid highway projects as of June 30, 1921 (the end of the governmental fiscal year), is given as follows in a tabulation issued recently by the U. S. Bureau of Public Roads: Number of projects, 746; mileage, 3,802.9; federal aid paid, $22,502,609.78; total cost, $51,860,009.18. The average cost per mile of all federal-aid highways built has been $13,635, distributed among the following three items: Surface, $9,040; grading, $2,938; structures, $1,657. Of the total money expended the amount which has gone into surfacing is: For Class 1 (gravel, sand-clay, top soil, shell, etc.) roads, $7,103,390.37, or 13.8 per cent; for Class 2 (macadam) roads, $3,587,258.51, or 7.0 per cent; for Class 3 (brick, block, portland cement concrete, and bituminous concrete) roads, $23,691,252.25, or 45.5 per cent; for grading, $11,175,276.28, or 21.5 per cent; for structures, $6,302,831.70, or 12.2 per cent.

Training Officers in the Corps of Engineers, U. S. Army

Extract from the Annual Report, for 1920-21, of the Chief of Engineers, U. S. A., Maj.-Gen. Lansing H. Beach.

ENGINEER officers of the Regular Army enter the service from two principal sources, military organizations and civil life. Officers from the first source include those commissioned from United States Military Academy, from the Regular Army, and from units of the Reserve Officers' Training Corps. Those from the second source have had little or no military training and usually enter the service within a short time after being graduated from civil technical institutions.

The difference in preparation prior to appointment in the army involves some variations in the training of these officers during their early years. Those entering the army with previous military experience usually require special stress on technical subjects in the formative period of their commissioned service, and those entering without previous military experience require special stress on subjects peculiar to the military profession, such as military art, military administration, military law, etc.

Some Sent to Technical Schools

On his initial entry into the Corps of Engineers the officer in the normal case is sent to the Engineer School at Camp A. A. Humphreys, Va., to pursue the basic course. This course, during the last year of five months' duration, comprises only elementary subjects such as administration, guard duty, law, military courtesy, military hygiene, hippology, field-service regulations, infantry and calvary drill, minor tactics, and troop leading, to include the company nomenclature, care and use of engineer equipment, map reproduction and photography, elementary bridges, railroads, etc. . . . The course was followed by actual service with troops.

While the basic course is adjusted as fully as possible to the varying needs of the student officers drawn from the several sources, it is evident that on its completion the fundamental differencies in the early training of these officers will not have been compensated. Those from the Military Academy and those from the best private military schools will usually be stronger on military subjects and weaker on technical subjects than those drawn from civil technical schools. These differences are taken into account in making the assignments for the six or seven years following the completion of the basic course.

The next step in school training is covered by the company commanders' course at the Engineer School and the civil engineering course conducted under the supervision of the Engineer School at high-grade civil technical institutions. All officers take the first of these two courses, but those who hold degrees from civil technical institutions of recognized excellence are not required to pursue the civil engineering course. They may, however, attend special courses in lieu thereof, such courses being designed to supplement their previous training.

Either before or after pursuing the company commander's course, officers commissioned from military sources are sent to civil institutions for one year of instruction in those technical subjects which either are not taught at West Point or which are given there in a very elementary form, but which are needed by the engineer officer in the discharge of his professional duties.

It is proposed that the policy adopted for this year's civil engineering course be continued, that is, that of sending the students to civil institutions of recognized high merit. This policy is not new. Since 1910 officers of the Corps of Engineers in small numbers have been sent to civil technical schools for instruction. Other government departments and arms of the service, notably the Navy, have committed themselves to it as a fixed policy. There are many good reasons for this policy, and the result of this year's work fully demonstrates its highly beneficial effects.

Among these reasons may be cited the psychological effect on the officer student and on the general public. In the past the military and the civil have been most distinct, both in training and method of life. This has led to mutual distrust, a pretended fear of militarism, which is not only bad for the service but ruinous to the country at large. Entirely due to ignorance of our former method of instructing our officers in technical subjects, civilian engineers have somewhat the same misgiving as to the professional attainments of army engineers. Such criticism is at this time quite prevalent in connection with the campaign for the creation of a department of public works. It is without foundation in fact and overlooks the achievements of army engineers which exist in public buildings and monuments, such as the Congressional Library and the Washington Monument; river and harbor improvements such as the Panama Canal, and the vast and complicated engineer undertakings in France, all of which were under the supervision of army engineers. Such doubts will disappear and no grounds whatever will exist for mistrust when the engineer in civil life realizes that his colleague in the army is a product of the same, an equal, or a better civil institution than himself. The reciprocal knowledge of the technical capacity of civil and military engineers will be established for all time by contact formed at these civilian institutions.

Another reason for the use of civilian institution for the civil engineering course is that by eliminating this course from the Engineer School proper the use as instructors of many high ranking officers may be avoided and much overhead expense may be thus eliminated. This point is particularly important at this time when the demand for economy is so great. It is to be noted if officers are to be developed as instructors of efficiency equal to those in civil institutions some of them must devote their entire life to pedagogical work and even then they may not reach so high a plane of teaching as those instructors in the best civilian schools. Still another reason for using civilian institutions for the civil engineering course is that better equipment can be obtained at less expense in the better civil institutions.

A consideration of the foregoing appears to show conclusively that the policy for instruction in technical subjects is sound. Officers of the Corps of Engineers should attend civil schools which possess ample equipment, a corps of selected instructors, with efficient courses and methods of instruction. Further, through the intimacy of college life mutual relations of respect and good will can be established and maintained between the professional military engineer and his colleague who remains in civil life. Such relations undoubtedly benefit the administration of government affairs, not only in time of war but in time of peace.

On completion of those two courses the officer spends two years in practical work in connection with river and harbor improvements or fortification projects and is then again detailed with troops for a period of two years. In addition to the practical work which can be furnished by the corps itself, officers are detailed to various industrial concerns, such as railroads, large construction companies, etc.

Later Training

The program above indicated covers the first six or seven years of the officer's commissioned service and during this period of service as a lieutenant, and, perhaps captain, aside from instruction received by school courses, he receives training in administrative and executive work as an assistant in the office of the Chief of Engineers or as an assistant to army, corps, or department engineers, or he may receive training in supply work as an assistant or a principal in charge of an engineer depot. He acquires experiences in construction as a district engineer or as an assistant to a district engineer on river and harbor and fortification work.

On or shortly prior to promotion to the grade of field officer he may take the field officers' course of approximately six months at the Engineer School, Camp A. A. Humphreys. This course endeavors to acquaint him with the duties of a field officer of engineers and of a staff officer for the Engineer Service. It stresses the relations of engineers with the staff and other troops. On completion of this course the officer is either sent to the school of the line or is returned to engineer duty.

Progress in Air Surveying

IN HIS report for the year ending June 30, 1921, just published, Col. E. Lester Jones, director of the U. S. Coast and Geodetic Survey, gives the following summary of the bureau's activities in connection with the work of aerial surveying:

The Mississippi River delta was photographed by the Air Service of the Navy during March, April, and May, 1921, for the use of this bureau in revising the chart of this area. Office work on these photographs is now in progress.

Atlantic City, N. J., and the vicinity was photographed in July, 1919, by the Air Services of the Army and Navy, and almost the whole of the outer coast line of New Jersey was photographed in March, 1920, by the Army Air Service. Revised charts of the New Jersey coast are now being compiled, and will soon be issued, showing corrections as obtained from these photographs. An officer of this bureau established the ground control and verified the results of the office compilation, making an examination of the photographic mosaics in the field.

The results of this work have produced some interesting and important conclusions in regard to chart revision: (1) The cost of the revision of the topography of the New Jersey coast by means of aerial photography is about one-third of the estimated cost by plane-table methods; (2) the inaccuracies to which aerial photographs are subject become negligible when reduced to a scale of 1:80,000, the scale of our coast charts; (3) no better historical record could be kept of shore-line changes than that furnished by aerial photographs, as every detail is shown.

Owing to lack of trained personnel, the Air Services of the Army and Navy have not been able so far to carry out a program of photographing portions of the Atlantic coast as requested by this bureau for the purpose of chart revision. The situation is improving and these services are planning to co-operate more fully in the near future.

An officer of this bureau has devoted practically all of his time during the year to the study of this subject and in keeping in touch with developments. Instruments for use in compiling data are being acquired. In June of this year a mathematician was assigned to devote a part of his time to the study of the mathematical problems connected with aerial surveying. A draftsman was also detailed for a portion of his time in order to become familiar with the process of compilation of data from photographs. In this way preparations are being made to handle photographs as they are received from the Air Services. The nucleus of an office and field force is being formed, so that when the time comes that the Air Services will be able to make extensive photographic surveys the Coast and Geodetic Survey will be ready to do its part with a small increase in personnel and the charts of the United States will be closer to perfection, as far as topographic features are concerned, than they ever have been before.

Too much stress can not be laid on this successful method of revising our shore topography, emphasizing *accuracy*, *economy*, and *speed*. But the Coast and Geodetic Survey does not maintain airships and seaplanes, and unless there is greater co-operation from the Army and Navy Air Services valuable time will be lost in supplying for charts and maps important information for commercial purposes on sea and land.

Paint Research To Be Undertaken

Research into the problems of the protecting power and durability of paint on wood is being planned by the Engineering Foundation. It is likely that the organization of the proposed investigation will be directed jointly by the Foundation, the Division of Engineering, and the Division of Chemistry and Chemical Technology of the National Research Council. The Foundation says that in view of the great annual expenditure for paint, about $300,000,000, it is important to have dependable information on the durability both of paint and of the wood which it protects.

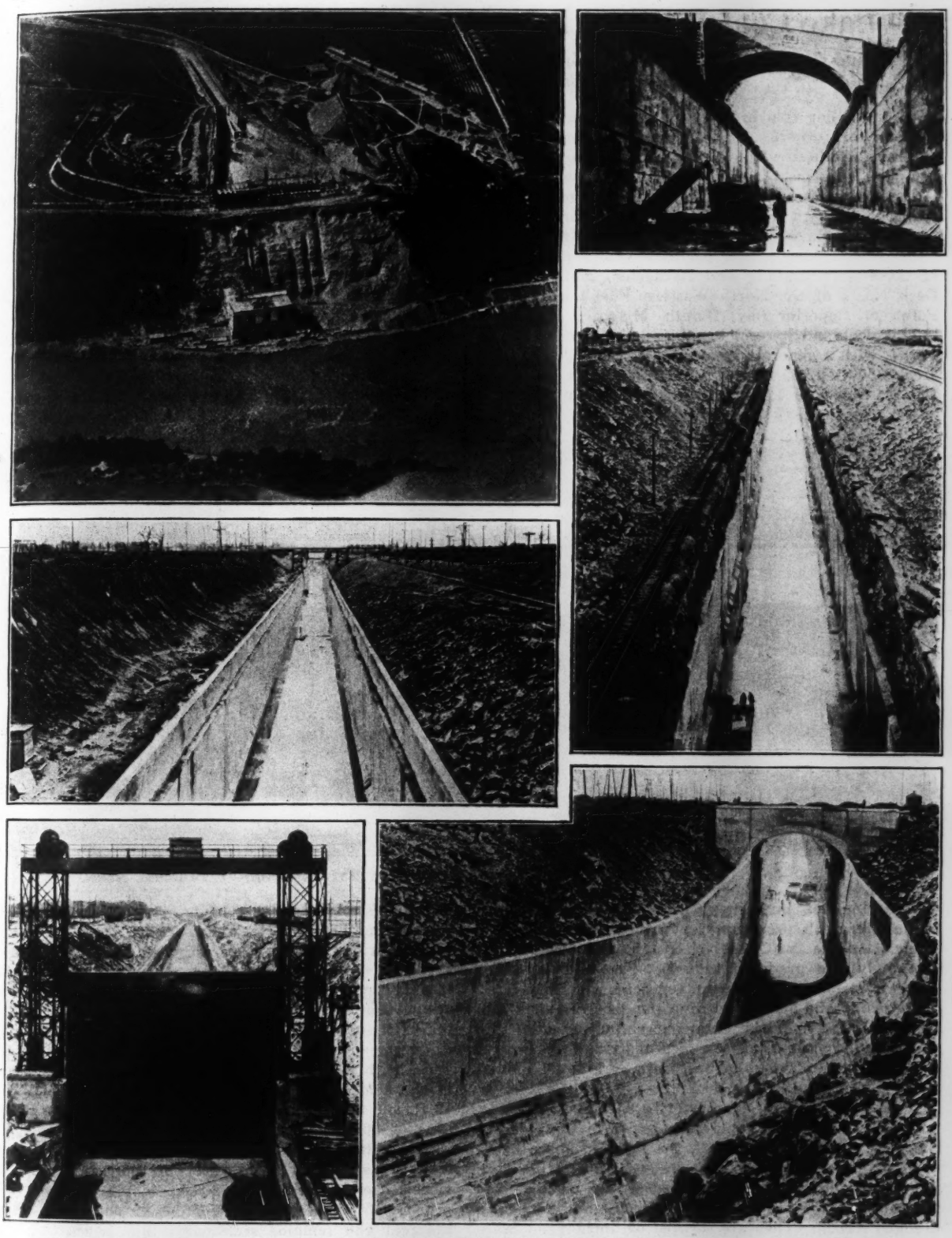
First Unit for Queenston-Chippawa Water Power Plant Opened

ON DEC. 28, 1921, the first unit of the new Queenston-Chippawa hydro-electric power plant around Niagara Falls was turned over with appropriate dedicatory exercises. This marks the beginning of the service of the 550,000-hp. development started before the war by the government of Ontario under the direction of the Hydro-Electric Power Commission of Ontario. On the opposite page are shown some views of the completed project, which has been described frequently in *Engineering News-Record*. As a matter of record here, however, there are set down below the main features in the development.

The project takes water from the Niagara River on the Canadian side, about 1½ miles above the Falls, and delivers it through a canalized river and dug canal a total distance of 13½ miles to a power house under the bluff on the lower river 5 miles below the Falls. The upper 4½ miles of this channel is in the Welland River, whose flow is reversed for that distance, and the canal section partly through rock and partly in earth cut is 8½ miles long. Approximately 15,000 sec.-ft. will be delivered through the canal to the forebay, at a level 305 ft. above the tail water. The total fall between Lake Erie and Lake Ontario is 327 ft., so that only 22 ft. is lost in the fall of the Niagara River and in the canal. The estimated total output of the canal is 550,000 hp., but at present only 275,000 hp. is to be developed, with five 55,000-hp. reaction turbines of the vertical single-runner type. These are connected to generators generating at 12,000 volts and 25 cycles. The voltage is increased to 110,000 for distribution.

The intake at the mouth of the Welland River was designed as a fingering tube arrangement drawing in water on the bottom element of the cylinder, but construction of this instake has not been carried beyond laying dry the site inside a cofferdam. The Welland River section was dredged by cableway excavators and by hydraulic machine, and the dredge worked its way for a mile up the canal section. From this point the canal is all in rock with the exception of a built up rock-filled section 2,500 ft. long across the gorge just above the Whirlpool, a relic of a former course of the Niagara River. Where the canal is in rock the sides and bottom are lined with concrete for the purpose of increasing its carrying capacity, and in the Whirlpool section the side slopes are heavily paved with concrete. The section of the river is 150-ft. bottom width with slopes of 2 on 1, through the main rock cut 48 ft. wide at the concrete lining. There is a 1 on 2 rock-paved earth slope above the rock cut where conditions require it. In the Whirlpool the bottom width is 10 ft. with a slope of 1½ on 1. At one point the bottom of the canal is 145 ft. below the original ground level. The maximum depth of cut in earth is 80 ft. and in rock 85 ft. The depth of the water in the canal is from 35 to 40 ft. The amount of material excavated from the canal proper is over 17,000,000 cu.yd. of earth and rock. The earth excavation amounts to 13,200,000 and the rock excavation to 4,182,000. Concrete in the amount of 450,000,000 cu.yd. has been used.

Early estimates of the cost of the canal, made before the increased costs due to war, have been greatly exceeded. While the figures are not now given out, it is reported that the total cost will be between $55,000,000 and $60,000,000 for the completed installation.



Views of the Completed Queenston-Chippawa Hydro-Electric Development Around Niagara Falls in Ontario

Upper left—Airplane View Looking Across the Niagara River at the Partly Completed Power House and Triangular Shaped Forebay. Aggregate Piles for Concrete Right of Forebay.

Middle left—Concrete-Lined Rock Section.

Lower left—Control Gate in Canal About a Mile Below the End of River Section.

Upper right—Bottom of the Completed Canal Under One of the Railroad Bridge Crossings.

Middle right—Looking Down on a Long Stretch of Tangent in the Rock Cut.

Lower right—Curved Section Near Transition Between Whirlpool Fill and Straight Section Beyond.

Lake Coal Dock with Unloading and Handling Plant

Crib and Concrete Dock—571 ft. Bridge with 10-ton Grab Unloads 625 Tons Hourly from Ship Screen and Conveyor Plants—500,000 Tons Storage

FOR handling coal brought by water from the lower lake ports, there are at Duluth, Superior and other points at the head of the Great Lakes, large coal docks equipped with machinery for unloading vessels, stocking and screening coal and shipping it by rail for distribution through the Northwest. These large storage facilities enable the fuel companies to supply their territory during long winter periods. One of the largest of these coal handling and storage docks is the new Dock No. 4 of the North Western Fuel Co. at Rice's Point, on Superior Bay, Duluth, Minn.

This dock and its coal handling bridge are shown in Fig. 1, with a general layout plan in Fig. 2. The filled area is 500 x 1,765 ft. and has on one side a vessel slip 150 ft. wide and 1,565 ft. long, with about 26 ft. of water. On the dock there is storage capacity for about 400,000 tons of bituminous coal and 90,000 tons of anthracite, with provision for future increase in the latter. As the two kinds of coal have to be handled separately and graded into various commercial sizes, there is elaborate equipment for screening, conveying and storing, and also for loading the different sizes into box cars and gondola cars for shipment, and into wagons and motor trucks for local distribution. Bunker coal can be supplied to harbor boats by a small fueling plant at the head of the dock.

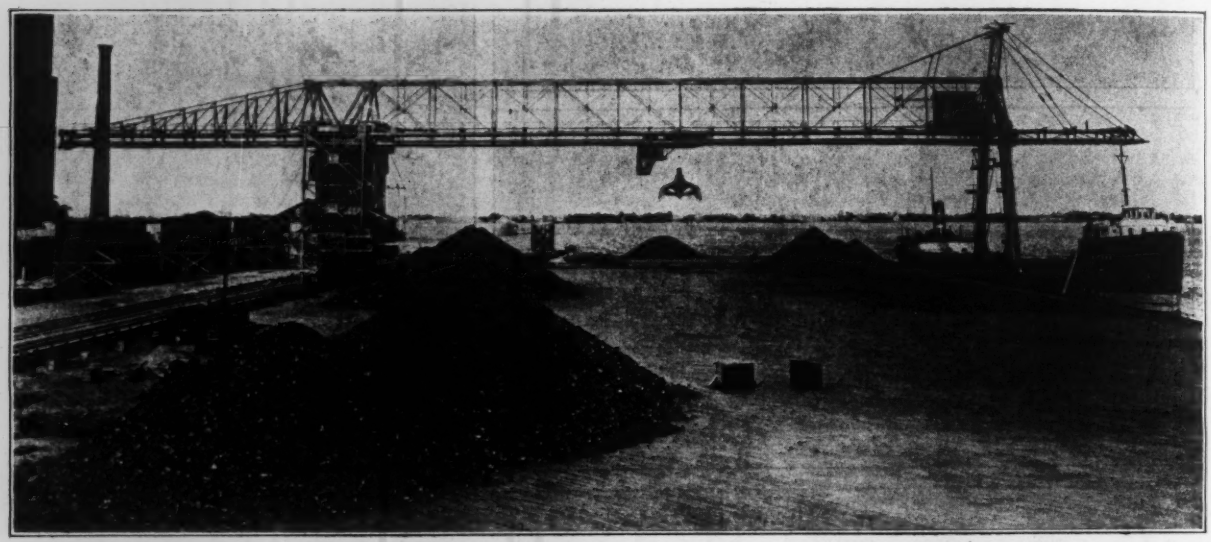


FIG. 1. COAL HANDLING BRIDGE ON DOCK NO. 4, NORTHWESTERN FUEL CO., DULUTH, MINN.

Dock Construction—Timber cribs 24 and 26-ft. wide, with sand filling and concrete caps, form the sides of the dock as shown in Fig. 3, the inclosed space being filled with sand pumped in by dredges. The cribs were built in a neighboring slip, floated to site, completed to the full height of 28 ft. and then loaded and sunk in a dredged trench. They are secured by anchor and brace piles inside of the rear wall. The heavy concrete cap on the dock wall has buttresses spaced 18 ft. c. to c., extending below and behind the wall and resting on interior piling. Expansion joints are placed every 160 ft.

For the front track of the coal handling bridge, white oak ties are embedded in the concrete, the rails resting on steel tie plates and being fastened with screw spikes. For the rear track, there is a reinforced-concrete girder on 3-pile bents spaced 3 ft. c. to c. with ½-in. steel plates or ties 3½ ft. long embedded in the concrete. These plates are 4-in. wide, except for 9-in. plates at the rail joints, and the rails are secured by clips on U-shaped anchor bolts. The rails weigh 100 lb. per yard and have special splice bars to allow the passage of the rail clamps of the coal handling bridge. Concrete bumping blocks at the ends of the tracks are fitted with timber bumpers and rope mats as shock absorbers.

A traveling bridge with trolley and grab bucket, Fig. 1, is installed for unloading vessels and for stocking and reclaiming the coal. Its unloading capacity is about 625 tons per hour when working in free coal. With a span of 342 ft. between supports the total length of the bridge is increased to 571½ ft. by a hinged apron at the water end and a cantilever extension at the rear end. The operating speeds are 200 ft. per minute for hoisting, 1,000 ft. for trolley travel and 50 to 70 ft. for traversing along the dock. Ordinary unloading is done with a 10-ton clamshell bucket 6½ ft. wide, with a spread of 22 ft. For cleaning up cargo in the hold a 6-ton bucket is used, having a width of 12 ft. and a spread of 24 ft. The buckets have a clearance of 50½ ft. above the dock floor.

Eight 30-in. single-flanged wheels travel on the front track and seventeen 24-in. wheels on the rear track. All wheels are driven from a 200-hp motor, but a clutch provides for traversing the front or shear end while the rear end remains stationary, thus permitting the bridge to be skewed about 6 deg. on either side of its normal center line. This arrangement avoids undue stress when the bridge gets out of square with its tracks, due to high wind or slipping of the wheels, and

it also enables the bridge to be squared up when necessary. Incidentally, it assists in adjusting the head of the bridge to vessel hatches.

For control of bridge movements there is an automatic cutout which operates at the speed limit, a solenoid brake and automatic rail clamps. The brake and clamps are normally applied, being released only when the bridge is to be moved. The three devices are interlocked so as to operate in proper order. Collectors on the rear leg of the bridge take current from conductors of 4 x 4-in. steel angles along the track.

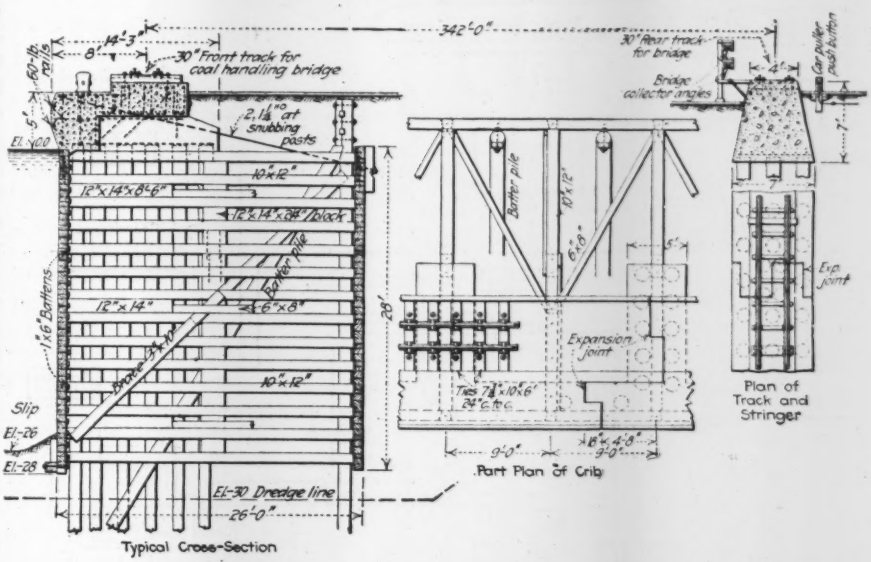


FIG. 3. CRIB DOCK WALL WITH CONCRETE CAP AND GIRDER

An elaborate plant for screening and sizing bituminous coal is mounted on the rear tower or pier of the coal-handling bridge, as shown in Fig. 4. This plant provides for loading coal into cars and it can also transfer the smaller sizes to stock piles or to six stationary bins on the dock by bucket elevators and belt conveyors. On the bridge tower are four 50-ton bins, one of which is for run-of-pile coal and is loaded directly from the clamshell bucket. The others are placed under the screens which prepare stove, nut and screening sizes. The flow diagram of the bituminous coal handling plant is shown in Fig. 5.

All sizes of coal can be delivered into box cars by means of two box-car loaders and two loading booms with belt conveyors, the latter being used also for loading open cars. It is possibe to load two cars simultaneously on either one or two tracks. The loading capacity of this bituminous plant varies from 2,000 to 6,000 tons in a 10-hour day, depending upon whether gondolas or box cars are being loaded, and also whether the loading is done at one or two points.

For local distribution of bituminous coal there are six 300-ton bins along the rear of the dock (see Figs. 1 and 2), each equipped with screens for sizing the coal and with chutes for loading wagons or motor trucks at the rate of about 1,000 tons in ten hours. For supplying fuel to harbor vessels there is at the end of the dock a plant with a timber runway, clamshell bucket and scraper bucket, operated by an electric hoist. These buckets serve a weighing hopper mounted on a 50-ton scale and feeding a belt conveyor operating on an adjustable boom.

Anthracite coal is stored under cover in a frame building 480 x 288 ft., inclosed by timber bulkheads and having a flat roof with hatchways 9 x 22 ft. for the clamshell buckets. The flow diagram for this section of the plant is shown in Fig. 6.

For removal of anthracite from the storage building there is a 36-in. belt conveyor, No. 1 (see Fig. 6), 517 ft. long, located in a reinforced-concrete tunnel on pile foundations. This tunnel, Fig. 7, extending the full width of the building, has a semicircular roof with openings fitted with chutes and undercut gates spaced 8 ft. c. to c., staggered on opposite sides of the tunnel. An electrically propelled feeder travels above the conveyor and delivers the coal from the chutes to the belt. Coal that does not flow by gravity to the tunnel is trimmed to it by means of flying steel scrapers operated

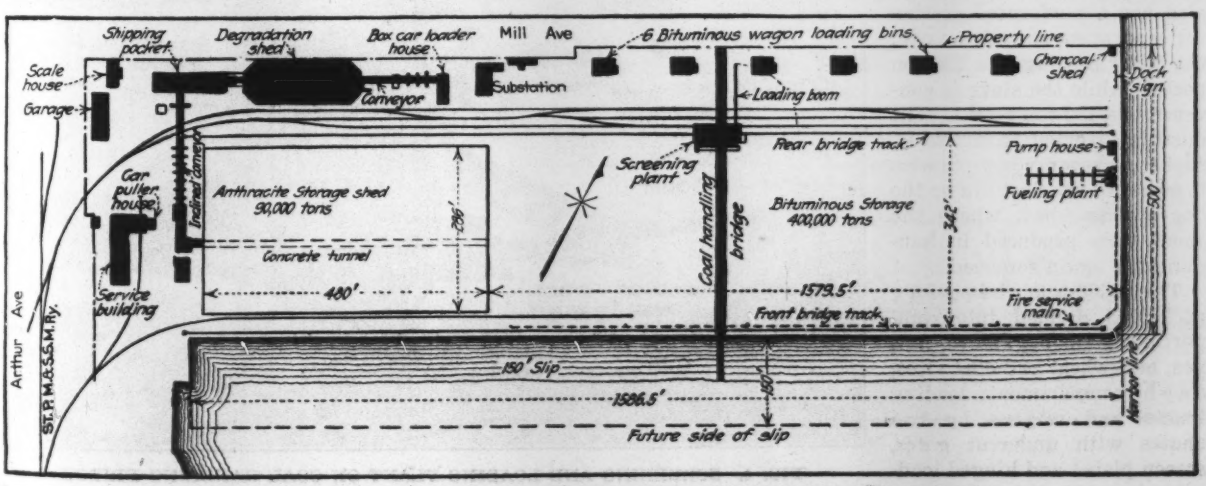


FIG. 2. DOCK FOR UNLOADING, STORING, SCREENING AND SHIPPING COAL

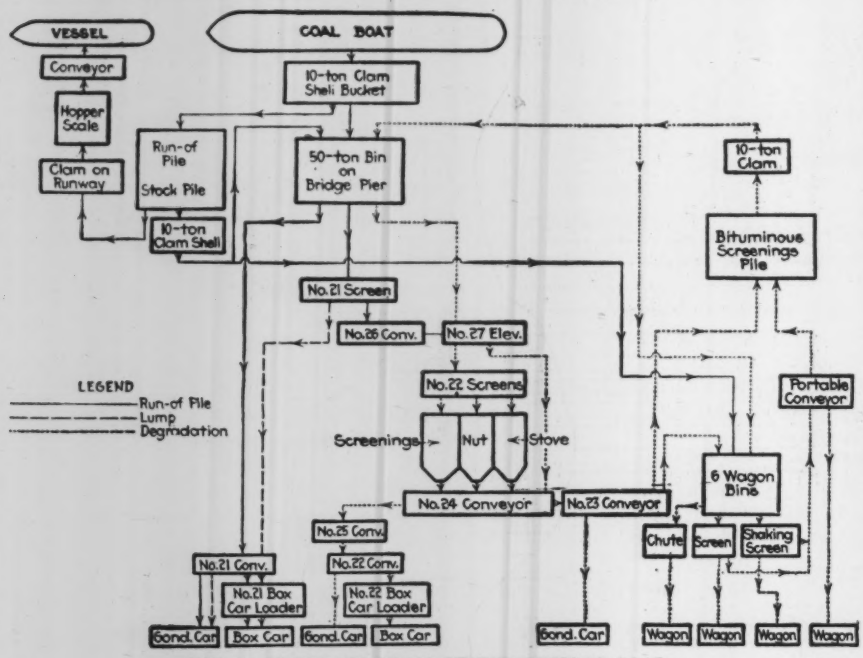


FIG. 5. FLOW DIAGRAM OF BITUMINOUS COAL

in pairs on single cables, handled by an electric hoist. An inclined 36-in. belt conveyor, No. 2, at right angles to No. 1 and 284 ft. long, receives the coal from the latter and transfers it to the shipping pocket. Each of these conveyors has a capacity of 300 tons per hour at a belt speed of 250 ft. per minute. A bifurcated chute with a flop gate at the head of No. 2 conveyor passes the stove and egg coal to cargo screen No. 1 or the nut coal screen No. 2. These screens are of the balanced horizontal shaking type, 6 ft. wide and 33 ft. and 43 ft. long.

When cargo egg or stove coal is to be screened, the coal is delivered to screen No. 1, from the lower deck of which the nut and smaller coal passes to No. 2 screen, where it is re-sized into nut, pea, buckwheat and dust. Screen No. 1 also has a perforated section for separating stove from egg, the latter passing to a 225-ton pocket, while the stove is conveyed to a 450-ton pocket. The dust is diverted to a 225-ft. flight conveyor which carries it either to the dust bin or the degradation shed, where the small sizes produced in handling are again screened.

The 1,600-ton shipping pocket is divided into compartments for egg, stove, nut, pea, buckwheat and dust sizes, each compartment loading trucks and wagons by two chutes with undercut gates, screen plates and hinged loading aprons. The degradation or undersize material is carried by 16-in. belt conveyors to a bucket elevator, No. 9, which either delivers it to No. 2 screen for re-sizing or diverts it to the flight conveyor for stocking in the degradation shed. For rail shipments, the pocket has 13 undercut gates which deliver coal to a 42-in. steel apron conveyor, No. 3, 120 ft. long and running at 80 ft. per minute. This conveyor in turn delivers the coal to No. 3 screen, the upper deck of which takes out any dust, buckwheat, pea and nut sizes which may have been made in the pockets. The small or degradation coal passing through this screen is delivered to 16-in. degradation belt conveyor No. 7, which in turn delivers it to No. 9 bucket elevator for rehandling.

Handling "Degradation" Coal—In preparing coal for shipment, degradation material is removed and finally separated into the smaller commercial sizes. In the 6,000-ton degradation shed is a crib tunnel with gate openings 10 ft. apart, through which, in reclaiming, mixed degradation material is delivered to belt conveyor No. 7, which carries it to No. 9 elevator for delivering it to No. 2 screen, where it is re-sized.

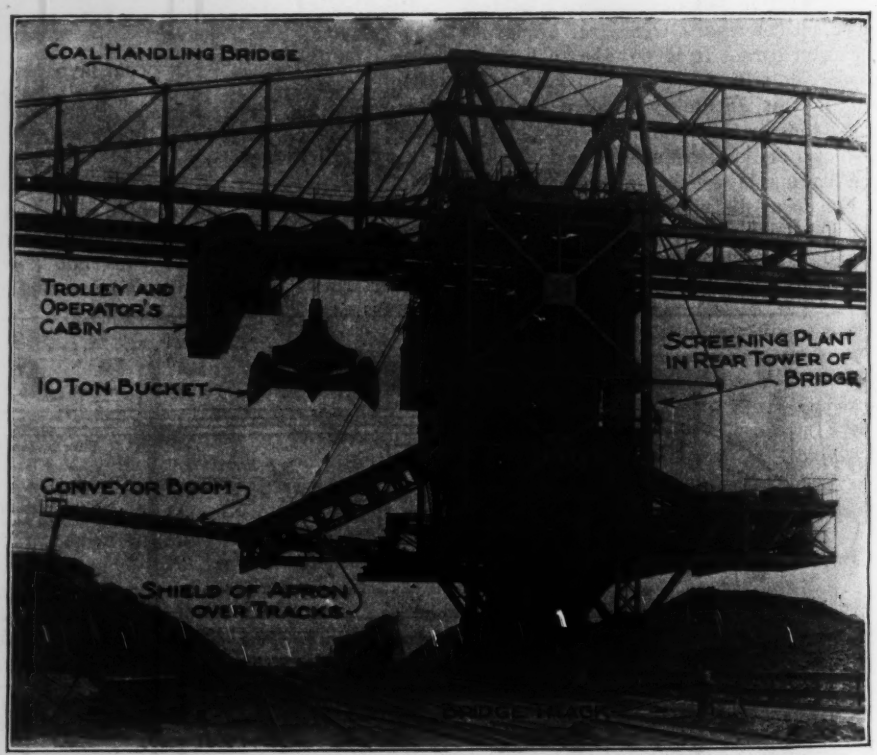

COAL HANDLING BRIDGE
TROLLEY AND OPERATOR'S CABIN
10 TON BUCKET
CONVEYOR BOOM
SHIELD OF APRON OVER TRACKS
SCREENING PLANT IN REAR TOWER OF BRIDGE

FIG. 4. SCREENING AND LOADING PLANT ON COAL HANDLING BRIDGE

Flying scrapers of the type described previously are used for trimming coal to this tunnel.

The coal passing over No. 3 screen is carried by a 42-in. inclined belt conveyor, No. 3½, to the loading shed for loading to cars, where it is delivered to a 42-in. hinged shuttle belt conveyor on loading boom No. 10.

Power and Miscellaneous Equipment

Alternating current at 13,200 volts, purchased from the Great Northern Power Co., is delivered by underground feeders at a substation, where it is converted to 600-volt direct current by transformers and rotary converters. For weighing shipments from the dock, there is a 150-ton track scale for cars, and one 20-ton and two 15-ton scales for trucks and wagons. The track scale is set 1.5 ft. above yard level to give a starting grade of about 1 per cent from the scale.

Railway tracks are laid with 85-lb. rails and No. 7 and No. 11 frogs; tamarac ties are used on straight track, curves having white oak ties, steel tie plates and bridle bars. A 50-hp. electric reversing car-puller mechanism, with endless rope system, serves all loading tracks, there being seventeen push button stations to start, stop and reverse the car puller rope. The entire dock is floored with 2-in. maple plank laid on 2 x 6-in. mudsills about 4 ft. c. to c., except that driveways have 3-in. maple plank. A steam fire pump serves 1,300 ft. of pipe having 2½-in. hose valves about 200 ft. c. to c., and a 6-in. fire main along the north side of the dock is connected to a city main and accessible to the fire department. There are also hose carts and closets and a number of fire extinguishers in the buildings. A brick service building contains the dock offices, storeroom, machine and electric repair shops, and quarters for the men. These quarters have hot and cold water and toilet facilities, including shower baths and lockers.

Engineers and Contractors

For the principal parts of the work the contractors were as follows: Dredging and filling, Great Lakes Dredge & Dock Co., Duluth; timber cribs, bridge tracks, concrete crib caps and a large portion of the structures, Morris & Dougherty and Peppard & Fulton, St. Paul and Minneapolis; coal handling bridge, Brown Hoisting Machinery Co., Cleveland, Ohio; anthracite handling equipment, Jacobsen & Schraeder, Chicago; substation equipment, Westinghouse Electric & Manufacturing Co. Scales, scrapers, fire service system, compressed air system, garage, electrical equipment and

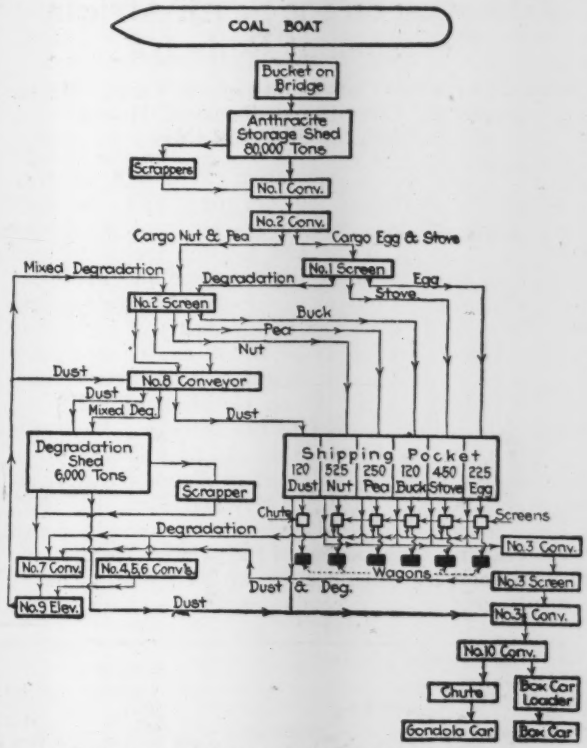


FIG. 6. FLOW DIAGRAM OF ANTHRACITE COAL

feeders and the boat fueling plant, were installed by the North Western Fuel Co. with its own forces. The concrete girder and pier type of construction for the front bridge track (Fig. 3) was suggested and designed by the firm of Toltz, King & Day, consulting engineers, St. Paul.

The general layout and detail design of this dock are the result of a study of requirements and local conditions, in which there was close co-operation between the management, the operating and engineering departments and the equipment manufacturers. Nathaniel Hanson was assistant engineer in charge of office work; L. Morris Mitchell, engineer in charge of construction from early in 1919 to the completion of the work; and Norman W. Rose, electrical engineer. All design, construction and installation were under the direction of G. H. Hutchinson, chief engineer of the North Western Fuel Co., St. Paul, Minn.

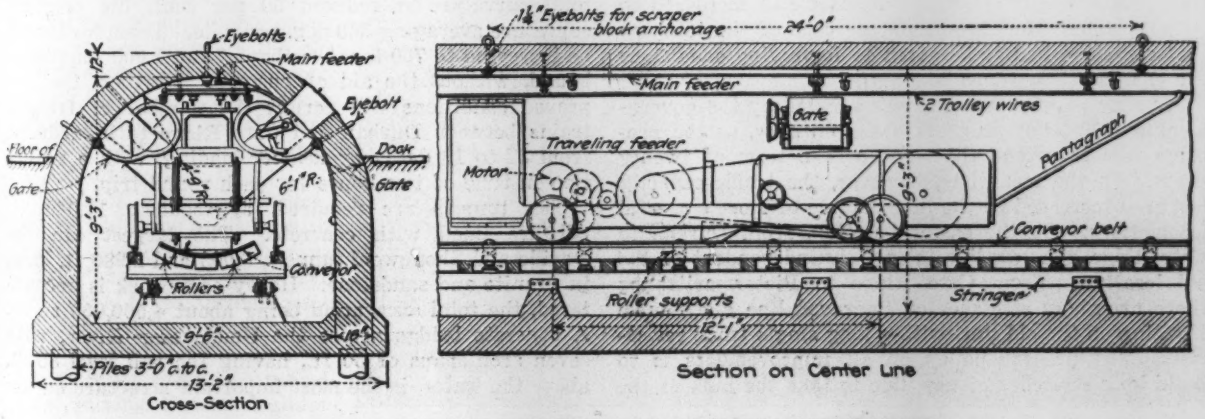


FIG. 7. TUNNEL AND CONVEYOR FOR REMOVING ANTHRACITE

Relocation on the South African Government Railways

Easier Grades and Curves on Detour Lines—Better Operating Conditions—Tunnels, Heavy Earthwork, Slides in Cuts

A SEVENTY-MILE relocation in rough country, reducing curvature 50 per cent and maximum grades from 3.3 per cent to 1.5 per cent, to permit handling traffic in fewer and heavier trains without pushers, is an example of improvement and relocation work being carried out on the South African Government Railways to meet the requirements of increasing traffic. This relocation is in Natal, on the line from the port of Durban to the inland city of Pietermaritzburg, a railway center, at an elevation of 2,218 ft., beyond which lines extend to the interior. It is this line which has been selected as the first section of an electrification program, as noted in *Engineering News-Record* of Jan. 29, 1920, p. 227, and Sept. 16, 1920, p. 558. A map of the old and new locations is shown in one drawing, with profiles of the principal part of the work in another. All lines are of 3 ft. 6 in. gage.

THIRTY-FOOT CONCRETE CULVERT IN HIGH FILL ON SOUTH AFRICAN RAILWAY

Heavy grades and excessive curvature characterized the original line, which was built more than forty years ago. It is considered that the 3.3 per cent limiting grades and 300-ft. radius curves were reasonable, but that an unnecessary amount of curvature was introduced owing to the fact that then train resistance due to curvature was not realized as it is today. In many cases sharp curves were introduced on maximum grades without compensation, so that the actual grade was equivalent to about 4 per cent. As early as 1895, reduction of curvature had been considered, with local relocation. At that time the inward or westbound traffic was by far the more important, but in 1905 the coal traffic from the interior to the coast had increased to such an extent that it was 54 per cent of the total, so that attention had to be given to improving conditions for eastbound movements.

LINE REVISION BETWEEN DURBAN AND PIETERMARITZBURG, SOUTH AFRICAN GOVERNMENT RAILWAYS

A policy of improvement was adopted by the government in 1903, but progress has been slow, as the program was to extend the work over a term of twenty years. In the meantime, however, the traffic capacity has been increased by the introduction of more powerful locomotives. On the eastern section, from Durban to Cato Ridge, the new line is entirely independent of the old location. From Cato Ridge to Pietermaritzburg there are short stretches of improved line and double tracking on the old line, with a long single track relocation. The present policy on all improvements is to build long stretches of new line to take the bulk of the traffic, leaving important sections of the old line in operation for local service and as a relief track. Originally it was the policy to follow the old location as much as possible, which prevented any comprehensive improvement.

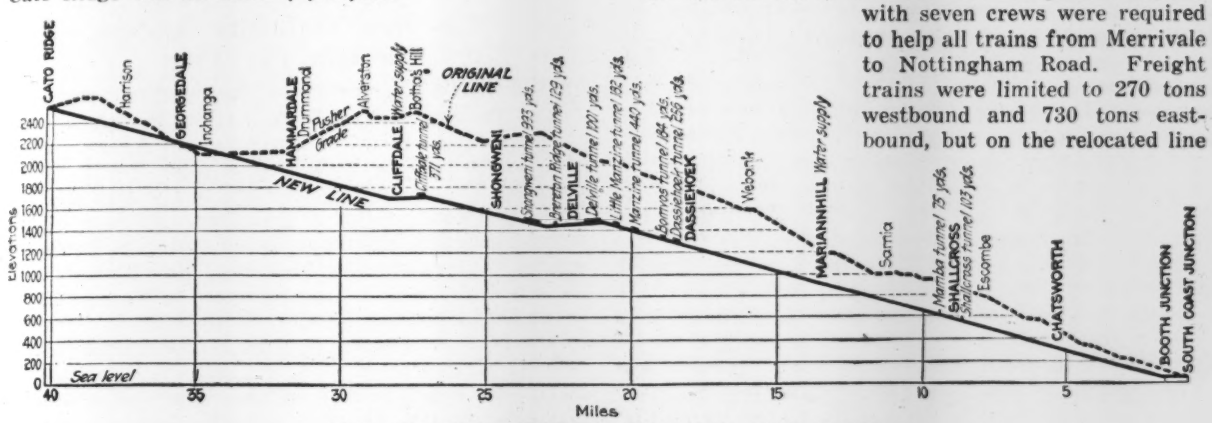
The heaviest work of the entire line is that between Durban and Cato Ridge. On the original location from Booth Junction (just outside Durban) there are grades of 3.3 per cent in both directions, as shown by the profile. Between Drummond and Alverstone is a grade of 3.3 per cent against the heavy eastbound traffic, so that two pusher engines and two crews are required. Freight train loads on this old line are limited to 245 tons westbound and 540 tons eastbound.

Surveys for relocation have been made at different times since 1902, but the route was not selected definitely until 1914. This route results in a much more regular profile or grade line. On the new location the maximum grades are 1.5 per cent westbound and 0.56 per cent eastbound, the total rise and fall is 600 ft. less, the distance is only 600 ft. longer. The sharpest curves are of 495 ft. instead of 300 ft. radius and the total curvature is reduced 50 per cent, the original curvature averaging 360 deg. per mile. Train loads will be increased to 700 tons westbound and 1,000 tons eastbound, without the aid of pushers. Further, the improved conditions will permit the number of freight trains between Durban and Cato Ridge to be reduced from 32 to 18 daily, by heavier loading, with a reduction in time of two hours for each round trip.

Ten tunnels are required, aggregating 11,040 ft. All are lined with concrete. The largest are the Deville and Shongweni tunnels, 3,003 and 2,980 ft. long, in granite and sandstone. Heavy earthwork is encountered, the total excavation being about 4,500,000 cu.yd. A concrete bridge across the Umhlatuzan River, with seven arch spans of 30 ft., having the rail level 85 ft. above the water, is the most important structure on the

main line. Near Clairwood the same river is crossed by a double track bridge having ten plate girder spans on concrete piers with concrete pile foundations. A 30-ft. concrete arch culvert carrying Sterk Spruit (or creek) through a high double track embankment near Cliffdale is shown in one of the views.

Ten stations are provided, at each of which is a passing siding 1,900 ft. long. The track is laid with 80-lb. rails on native hardwood ties. Work has been delayed by bad weather and the shortage of railway and building materials, especially cement, but it was expected to have the grading and tunnels completed during 1921. The cost of the new line between Durban and Cato Ridge will be about $5,000,000.



OLD AND NEW PROFILES—DURBAN TO CATO RIDGE

On the western section, from Cato Ridge to Pietermaritzburg, there is a long ruling grade of 3.3 per cent from Pentrich to Fox Hill, opposed to the heavy eastbound traffic. A long single track relocation eliminates this operating obstacle. With an increase of ¾-mile in distance the new line reduces the maximum grade eastbound to 1 per cent and westbound to 1.43 instead of 2.1 per cent; the sharpest curves are of 720 ft. instead of 300 ft. radius, the total curvature is reduced by 2,317 deg., total rise and fall is reduced by 235 ft., and five pusher engines have been released.

Very heavy earthwork has been required. The total cost of the improvement of the western section, including the relocation and two stretches of double tracking on the old line will be about $2,100,000. An existing branch from Thornville to Richmond makes it necessary to retain the old line in service, an arrangement which fits in with the present policy of keeping the old lines for local and auxiliary service, as noted above.

West of Pietermaritzburg, on the main line to Ladysmith and Johannesburg, improvements have been made for about fifty miles, including relocation, grade reduction and double tracking. On the first twelve miles there is a tunnel 2,727 ft. long. Extensive slides in the long cuts were a cause of considerable trouble. At one point the sliding hillside was checked in 1917 by building a toe, on the up-hill side of the roadbed, consisting of 5,000 tons of stone anchored by old rails on steel ties. The ties were placed vertically, with the horizontal rails forming an anchorage. Three or four rows of ties were used, with rock filling between them. In addition, forty-eight concrete struts were built under the track, transmitting the pressure to solid ground on the down-hill side of the cut. This proved successful until the severe storms and floods of 1917 occurred, when the saturated hillside slid down and blocked a number of cuts. Extensive works were needed to give permanent relief from such occurrences.

In this section of the old line five pusher engines with seven crews were required to help all trains from Merrivale to Nottingham Road. Freight trains were limited to 270 tons westbound and 730 tons eastbound, but on the relocated line these loads will be increased to 415 and 1,000 tons respectively. The length of this improved section is 21½ miles, an increase of 1¾ miles, with maximum grade of 2 per cent westbound and 1.5 build per cent eastbound, 162 ft. reduction in rise and fall, curves of 495 ft. instead of 300 ft. radius, and a reduction of 3,114 deg. in total curvature.

The importance of this Cato Ridge-Clairwood relocation is evidenced by the following statement in the report for 1920-21 by R. C. Wallace, the present chief civil engineer of the government railways: "This deviation embraces the heaviest piece of railway con-

CONCRETE ARCH BRIDGE OVER UMHLATUZAN RIVER

struction in the Union of South Africa, and must certainly rank high in the records of railway construction in any part of the world. But although the construction work has been of such magnitude, the real engineering problem was the survey, which is the most brilliant piece of location ever done in South Africa. It will always remain an eloquent testimony to the railway engineering skill of this country."

The improvement works are being carried out under the direction of Sir W. W. Hoy, general manager, Railways and Harbors, Union of South Africa. A. M. Tippett is engineer in chief, and A. J. Beaton has been acting engineer in chief during Mr. Tippett's absence in Europe.

Low Friction Loss in Twenty-Five-Year Old Cast-Iron Pipe

By Thomas F. Wolfe
Secretary, The Cast Iron Pipe Publicity Bureau, Chicago, Ill.

In the design of water-works systems the common practice is to assume that the loss of head due to friction increases with the age of the pipe. The standard formulas for friction loss take this fact into account. In many cases it is time that the friction increases with the age of the pipe but, with certain waters, the loss does not increase appreciably even over a great number of years. Although the use of formulas that pre-suppose an increased friction loss with age is on the safe side, it will pay in many instances to investigate the quality of the water that is to flow through the lines and to base the size of the pipe on the probable condition of that particular pipe after a number of years' service. Along these lines some information was unearthed in a recent water survey for leakage made at Hammond, Ind. The data cited below were not collected for the purpose of determining friction loss but as ordinary care was taken in making readings, and the length of pipe tested was more than 15,000 ft. a slight error in pressure readings would make little difference in resulting coefficients.

FRICTION FACTORS IN AN OLD 24-IN. CAST-IRON PIPE

Velocity	Loss Between Observation Points, Lb.*	Loss in Feet, per 1,000 Ft.	Coefficient — Hazen-Williams Formula	Coefficient — "n" in Kutter's Formula	Loss per 1000 Ft. New Pipe by Weston
4.86	20	3.00	131.4	0.0109	3.80
4.75	17	2.53	140.8	0.0103	3.64
4.24	16	2.38	130.0	0.0112	2.89
4.30	15	2.23	136.5	0.0106	2.97
Average			134.7	0.0107	

* No difference in elevation of gauges.

The line tested was a 24-in. main running from the pumping station at the shore of Lake Michigan to the town of Hammond about five miles inland. A few connections tap into this main near the pumping station and then for a distance of 16,000 ft. there are no connections. To determine the leakage, two pitometer taps were installed, the distance between taps being 15,500 ft. The pipe, coefficients determined by traverse across one diameter at each tap were 0.82 for the "inflow" tap and 0.83 at the "outflow" tap. A 20-min. flow test was made, taking manometer readings every 15 sec. and pressure readings every minute. In order to eliminate possible instrument errors, the position of the pitometer rods was reversed after half the readings were made. The average of 80 simultaneous readings on the two taps indicated no readable difference in velocity. While this showing does not necessarily mean an absolute absence of leaks, the leakage is negligible.

It will be seen from the above results that in spite of the fact that this pipe has been in service more than 25 years, the loss in head is less than that shown in Weston's Tables for new pipe, and the coefficients in both the Hazen-Williams and Kutter's formulas approach very nearly the values for new pipe. The piece taken out when a 16-in. cut was made on this main, showed that the coating on the inside as well as the outside was in perfect condition.

This survey was made by W. R. Brown, of Chicago. John Ericson of Chicago is consulting engineer.

Why New York City Opposes The Joint Port Plan

At a recent meeting of the municipal engineers of the city of New York, Arthur M. Tuttle, chief engineer of the Board of Estimate and Apportionment of the city of New York read a paper entitled "The Narrows Tunnel and Its Relation to the Port of New York Problem." After a prefatory statement of the freight handling difficulties in the port, Mr. Tuttle described the formation of the Port of New York Authority and made the following reference to the conflict between that body and the city, particularly in reference to the port development scheme of the former (*Engineering News-Record*, Jan. 5, 1922, p. 26) and the Narrows Tunnel scheme of the latter (*Engineering News-Record*, Oct. 27, 1921, p. 704):

From the date of the creation of the New York-New Jersey Port and Harbor Development Commission to the present, there seems to have been a growing hostility to this body and to its successor on the part of the municipal authorities in New York City, who are given no voice in the formulation or management of the proposed undertaking, the naturalness and occasion for which it is not difficult to see. The intrusion of the state into the management of the city has been the occasion for growing resentment which has recently been emphatically expressed. It is furthermore evident that there can be no guarantee that the jealousy of local community interests, which it is sought to avoid, will not crop out with equal force in the bi-state commission, and as the terms of the proposed union of port interests are so binding that it would be very difficult to withdraw from them even if the consolidation of interests should later prove ineffective or unsatisfactory, the resulting confusion in case of a deadlock might prove disastrous. Again, the pooling, on equal terms, of the economic interests of a single community of nearly 6,000,000 inhabitants with those of 104 scattered municipalities having a total population of about 2,500,000 and very much smaller assets, does not represent what would seem to be a sound policy, and particularly when the issues involved are of only a general character and do not bear with equal force upon the respective parties, the one having the lesser interest taking a far less risk than the other as to the outcome of the combination.

If the principle be accepted as a correct one, it would seem to follow that similar bi-state commissions should take general charge of the water-supply, drainage and sewerage, and rapid transit problems of the metropolitan district regardless of state lines. While such an arrangement might be considered as advantageous in many respects, the conflict of laws and interests by reason of dual jurisdiction which could not be fully avoided, with the possibility of resulting endless confusion and clash would seem to warrant very serious hesitation over any such commitment, but would rather point either to a joining of state interests only in the carrying out of particular and clearly defined projects or the setting up of an independent state as a better means of securing the desired end. If the former alternative is selected, it would also seem that the interests of the City of New York, financial and otherwise, should always be recognized by at least giving it strong direct representation on any such bi-state commission in which its affairs are so deeply concerned.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Colonel Prout's George Westinghouse

A LIFE OF GEORGE WESTINGHOUSE—By Henry G. Prout, C.E., A.M., LL.D. New York: Charles Scribner's Sons. Cloth; 6 x 9 in.; pp. 375; 9 illustrations. $2.50.

The writing of this illuminating biography of George Westinghouse is due to the initiative of the American Society of Mechanical Engineers, and is a continuation of the effort begun twelve years ago when the John Fritz's autobiography was published under the auspices of the same body. The committee in charge of the present work was composed of Charles A. Terry, as chairman, Paul D. Cravath, Alexander C. Humphreys, James H. McGraw, Charles F. Scott, Lewis B. Stillwell and Ambrose Swasey. The writer of the biography, Col. Henry G. Prout, was well qualified for the work by his long connection with Westinghouse, as president of the Union Switch & Signal Co., and by his experience as editor of the *Railroad Gazette*, in which position he was conceded to be one of the leaders in American technical journalism. He brought to the work, then, a thorough understanding of Westinghouse, and the ability to put his thoughts in writing.

The book is divided into two general parts: (1) The first and the last two chapters sketch the life of Westinghouse, picture his character, and interpret the influence of his efforts on human progress; (2) the other chapters go into details regarding his inventions and enterprises.

Taken as a whole, the biography will appeal chiefly to engineers, though the general chapters are sure to interest and be of value to any reader. The other chapters are necessarily technical, and will be followed closely by those who want a clear record of the various devices and enterprises with which Westinghouse was concerned.

These chapters, however, though dealing with technical development, shed illuminating light upon Westinghouse's character and methods. In fact, only by reading them does one get the full story—a true appreciation of his imagination, his engineering resourcefulness, his courage, his marvelous persistence, his ability as an organizer, his leadership of men.

Between the technical chapters there is not much to choose. Some of them tell of Westinghouse's personal inventive ability; some, of his direction of developments whose details were worked out by his subordinates. Each class of activity, however, carries its own special inspiration. In one chapter we get the fascinating story of the air brake; in another, Westinghouse's influence in making practicable, largely through the development of the transformer, the commercial use of alternating current; in another, the inventions in the art of railway signalling; in still another, his work on steam turbines, on reduction gears, on the friction draft gear. The list is a long one. Not the least interesting and illuminating of the specific chapters is the one on his financing methods.

The last chapter is the most important. It is an attempt—and a happy one—to appraise the influence of Westinghouse upon human progress. The author rightly gives him a high place—for the influence of the air-brake and automatic signalling on transportation, and for the commercial introduction of alternating current. Railroad transportation today, with all of its socializing influence, would be impossible without the air-brake and automatic signalling. Col. Prout rightly calls these devices essential contributions to the greatest of material civilizing agencies. Hardly of less importance is the introduction of the alternating current, a veritable obsession with Westinghouse, in which he met obstacles and opposition which would have overwhelmed a less stout-hearted and determined character. It need not be told any engineer that the basis of our marvelous distribution of electric power today is the alternating current. Westinghouse championed it when it had no other friend.

All in all the book gives an excellent picture of one of the country's great engineers and industrial leaders. It furnishes much inspiration and holds many valuable lessons for all who would aspire to high place whether in business or in engineering.

A Handy Book on Railway Signaling

BY J. A. PEABODY

Signal Engineer, Chicago & Northwestern Ry.

RAILWAY SIGNALING—By Everett Edgar Kink, Member of the American Railway Association, Signal Section, Member of the American Railway Engineering Association, Associate Member of the American Society of Civil Engineers; Professor of Railway Civil Engineering in the University of Illinois. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 371; illustrated. $4.

There is such a dearth of concise information on railway signaling that this book is timely and interesting. After a preliminary chapter, the author describes types of position and light signals. Then in two chapters he describes mechanical interlocking very clearly, dividing this into the portions inside and outside of the tower. Good illustrations of the various parts, particularly of the machine and descriptions of the uses of the parts, assist in the description. This applies particularly to the machine locking, which so many find hard to understand. Other chapters are devoted to electro-pneumatic interlocking and electrical interlocking.

The chapter on direct-current circuits starts out with a diagram of the track circuit and a very brief description of its purpose. It would seem that this essential part of signaling could, with benefit, have been given more nearly equal attention to that given the very complete chapter on automatic block signaling on track with alternating current circuits. An instructive chapter on automatic block signaling on single track analyzes clearly the various systems used. The various types of power signal mechanisms are illustrated and described in a manner similar to that in which the subject of interlocking is handled. But a paragraph on automatic stops is so brief as to be misleading, since it gives the impression that it describes the only type of automatic stop devised. A chapter on highway crossing signals shows the methods of control of automatic flagmen and bells. Appendices include information of general use.

In all cases the treatment is brief, but particularly

so in regard to batteries and current consumption. Nothing is said as to such recent developments as trickle charging of batteries. Difficulties that may be experienced in maintenance of signal work are not touched upon, but criticism as to difficulties would apply to most books of this class.

Both test and illustrations are well put together and clearly printed. The work is in text book form, with a good table of contents and well indexed, and is therefore handy as a reference book for experts, and also for division engineers and other railroad officials who want general information rather than details. It will be of interest also to signalmen and students of railway engineering.

Kidder and Nolan's Architects' Handbook

THE ARCHITECTS' AND BUILDERS' HANDBOOK: Data for Architects, Structural Engineers, Contractors, and Draftsmen—By the Late Frank E. Kidder, C.E., Ph.D., Author of "Building Construction and Superintendence." Compiled by a Staff of Specialists and Thomas Nolan, M.S., A.M., Editor-in-Chief, Fellow A. I. A., Professor of Architectural Construction, University of Pennsylvania. Seventeenth Edition, Enlarged. Total Issue, 85,000. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Limited. Flexible; 5 x 9 in.; pp. 1,907. $7; 42s. net.

One of the oldest and best of the handbooks, Kidder's, was extensively revised a few years ago under the editorship of Thomas Nolan and with a staff of specialists as associate editors. (See this section in *Engineering News*, May 18, 1916, p. 941, for details.) In the present edition 29 chapters of the sixteenth edition "have been revised where necessary to make the data agree with the latest research and practice," and two new chapters have been added. Of the new chapters, one on Specifications for the Steelwork of Buildings is by Robins Fleming and one on Domical and Vaulted Structures is by Edward P. Ries. The chapters in the sixteenth edition dealing with fireproofing of buildings and reinforced-concrete construction have been rewritten by Rudolph P. Miller. Other portions that have been rewritten are the sections on heating and ventilation and on chimney construction, by Louis A. Harding. Less extensive new material deals with building laws governing masonry loads and presents data on girderless reinforced concrete floors and on tanks, and the registration of architects. Standard documents of the American Institute of Architects and architectural education are also considered. Cuts have been added and some of the old ones made anew. The new edition with its many revisions and additions is a credit to all concerned.

Masonry and Concrete Construction

ENGINEERING CONSTRUCTION IN MASONRY AND CONCRETE: Part II—William Henry Warren, LL.D., Whitworth Scholar; M. Am. Soc. C. E., Challis Professor of Engineering and Dean of the Faculty of Engineering, University of Sidney. New York and London: Longmans, Green and Co. Cloth; 6 x 9 in.; pp. 498; illustrated. $12.

This is one of the few British civil engineer's books which show any recognition whatever of American engineering practice; obviously the author has read some American books and periodicals on engineering design and construction. Previous investigation of British text books would lead one to believe that he is a unique example among his fellows. The explanation probably lies in the fact that he is a professor of engineering in the University of Sydney, Australia. It is a difficult matter to write anything very new on the subject which Professor Warren has undertaken. The best that can be said of the new books on this subject is that they adequately take care of the details which are available, but which may be in other books treated in a less well balanced manner. There is some additional interest in the book before us in that the practice in foundations in some Australian bridges is rather carefully gone into.

British Studies of Concrete Aggregates

GEOLOGICAL AND PHYSICAL CHARACTERS OF CONCRETE AGGREGATES: With Special reference to British Resources as illustrated by the Aggregates. Used in a Series of Fire Tests Conducted by the British Fire Prevention Committee (1917 to 1919)—A Memoir by Arthur Holmes, D.Sc., F.G.S., Technical Assistant to the Committee; with an Introduction by Prof. W. W. Watts, F.R.S. Red Book 256, British Fire Prevention Committee. London: His Majesties' Stationery Office. Paper; 6 x 9 in.; pp. 171; illustrated. 10s. net.

While this "Red Book" of the British Fire Prevention Committee is a distinctly British production in that it relates to the economic geology of aggregates in Great Britain, it should have some value to American investigators of similar lines. It is concerned primarily with the fire resistance properties of concrete, but it contains also a survey of all the British concrete aggregates. It is stated that the "general outcome of the investigation seems to show that, valuable as they are under normal conditions, concretes with siliceous ingredients in the coarse aggregate are generally untrustworthy both in themselves and in relation to other materials used in association with them when submitted to high temperatures. At the same time it appears that rocks with a coarse texture, whether crystalline or clastic, are inferior to fine-grained rocks. Rocks devoid of flint and quartz and particularly fine grained varieties seem to stand up much better, while limestone has proved to possess many qualities of high value for fire resistance slabs. Of the artificial materials those which have already been submitted to high temperatures before use, like brick and slags, have often good fire resistance qualities. It is perhaps unlikely that some of these materials will find favor when so used if they are subject to a moist climate and the influence of the weather."

Building and General Sanitation

DRAINAGE AND SANITATION: A Practical Exposition of the Conditions Vital to Healthy Buildings, their Surroundings and Construction, their Ventilation, Heating, Lighting, Water and Waste Services; for the use of Architects, Surveyors, Engineers, Health Officers, Sanitary Inspectors, and for Candidates preparing for the Examination of the various Professional Institutions—By E. H. Blake, Member of the Royal Sanitary Institute, Vice-President of the Institution of Sanitary Engineers. Second Edition. London: B. T. Batsford, Ltd.; New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 519; 379 Illustrations specially drawn by the Author. $4.50.

From the viewpoint of British theory and practice this is a comprehensive and satisfactory treatise on the subjects indicated by the title and subtitle. The scope of the volume extends beyond the building, so as to include water supply, sewerage and the final disposal of sewage and refuse. There is a chapter on sanitary surveys and reports and another one consisting of legal notes. Judging from the chapters on sewage and refuse disposal the revision of the first or 1913 edition has not been thorough, as there is nothing on the activated-sludge process or on garbage utilization by feeding to hogs and other changes from refuse disposal by incineration.

New German Journal on Railway Shops

Beginning in January a new monthly journal called *Das Eisenbahnwerk* (*The Railway Shop*) is being issued in Germany. The editor is Dr. Hans A. Martens. The publisher is H. Apitz, Berlin W 57, Mansteinstre 12.

Standard German Work on Steel Making

Reviewed by RICHARD MOLDENKE
Consulting Metallurgist, Watchung, N. J.

LEHRBUCH DES EISENHUTTENKUNDE: Verfasst Für Den Unterricht, Den Betrieb und Das Entwerfen von Eisenhuttenlagen. Von Bernard Osann, Professor An Der Bergakademie In Clausthal Geheimer Bergrat. Zweiter Band: Erzeugung Und Eigenschaften Des Schmiedbaren Eisens. Mit 651 Abbildungen Im Text Und 10 Tafeln. Leipzig: Wilhelm Engelmann. Cloth; 6 x 9 in.; pp. 794. Paper, 145 marks; cloth, 175 marks.

Five years have passed since the publication of Prof. Osann's first volume on the Metallurgy of Iron and Steel. The blast furnace was the subject matter of that book. [Reviewed by Mr. Moldenke in *Engineering News*, Dec. 16, 1915, p. 1175.—EDITOR.] Now we have the iron and steel-making processes based upon the blast furnace product. Together with the well known book of the same author on the iron and steel foundry, now in its fourth edition, there is available an up-to-date, comprehensive treatment of the metallurgy of iron which should be in possession of every engineer and metallurgist able to follow the German text. The books are naturally written with the requirements of German economic conditions in view, and hence much attention is given to the basic converter process, not used at all in the United States, but peculiarly adapted to the high phosphorous ore conditions of Germany, with the commercial value of the slags made into fertilizers. Similarly, the mechanical puddling processes for wrought iron are not taken up, this portion of the iron industry being practically obsolete in Germany. None the less, after going into a discussion of fuels and refractories, the making of wrought iron is briefly described for its historical interest.

Every detail of converter construction and operation is gone into thoroughly and well illustrated. Many examples of heat calculations are worked out, so that the student as well as plant metallurgist can follow out the economy of operation intelligently. Attention is also given to small converters. The converter processes for steel-making take up about 200 pp. of the book.

The open hearth processes come next. After the general history of this development, producer and other gases are discussed in some 60 pp. American engineers will be interested in the descriptions of gas made from peat and lignite, as also in the discussion of the rôle of hydrogen in producer gas. The utilization of the by-products from bituminous coal is so thorough in Germany that producer gas is usually made with coke as the basis. Hence the special attention given this phase of gas-making. Water-gas, Mond-gas and other fuel gases are also described.

The open hearth processes and their duplexing variations occupy about 100 pp. One readily sees how it has been possible, by means of the refinements in the processes developed, for Germany to have produced so much high class steel from what we would call inferior raw materials.

A chapter on crucible steel follows, the melting process itself and that of alloy steels being described briefly. More attention is devoted to electric steel-making, but even here the subject matter could have been further extended in view of its increasing importance. Doubtless the author will do this in a subsequent edition, when information of what has transpired outside Germany during the war will be better available to him. Copious titles of published articles are, however, given, so that those interested may delve into details the author may not yet consider ready for full acceptance.

A very complete chapter—so far as the requirements of the book are concerned—on cementation and case-hardening, the malleable castings' annealing process, heat treatment of armor plate, tools, and a variety of special steel products, follows. Then comes 60 pp. on furnace construction for these purposes, such as soaking pits, annealing and heating furnaces. A final section deals with the metallographic side of steel and the methods of testing used to ascertain its value.

Prof. Osann's work on the metallurgy of iron and steel is unquestionably the standard text and reference book on the subject in Germany today, and as such is well worth study on this side of the ocean.

South African Irrigation Magazine

A commendable new venture in the field of government periodicals is the *South African Irrigation Department Magazine* (A. D. Lewis, Director of Irrigation, Union Building, Pretoria). The first issue contains departmental staff contributions on a variety of irrigation and related subjects. There is an article of some length on the Hertebeestpoort dam, a structure of the constant-angle arch type which will have a total height of 198 ft. above the lowest foundations, a thickness of 72 ft. at the bottom and 15 ft. at the top, a crest length of 450 ft. and a crest radius of 225 ft. for the downstream face. Construction is now well under way. There are also notes on a number of other dams and some interesting meteorological and stream flow statistics.

Fire Tests of Protected Columns

An abstract has been made of the Underwriters Laboratories' exhaustive report on fire tests of columns, the abstract covering only the behavior of gypsum, clay tile, and related coverings. In this abstract the favorable showing made by gypsum is brought to the front. It was prepared by George H. Graves, consulting engineer, for the Gypsum Industries Association (111 W. Washington St., Chicago). Unfortunately, the title page does not make it clear that the digest covers only part of the total investigation made at the Underwriters Laboratories. However, in the text itself this is sufficiently clear.

McGraw-Hill Company Papers

Beginning Jan. 15, the McGraw-Hill Company, Inc., began the publication of two new papers, *Bus Transportation* in New York and *Electrical Review and Industrial Engineer* in Chicago.

Bus Transportation is an outgrowth of the demand in the urban and suburban transportation field for data upon the operation of motor buses. It is thus an outgrowth of the *Electric Railway Journal*, one of the oldest properties of the McGraw-Hill Co. The new magazine will be published monthly under the editorship of Harold V. Bozell, who is co-editor of the *Electric Railway Journal*.

Electrical Review and Industrial Engineer is the converted form of the *Electrical Review*, long published at Chicago and recently purchased by the McGraw-Hill Co. It has been changed from a weekly to a monthly publication and will be devoted to the interests of those who operate and maintain electrical and mechanical equipment in mills and factories. D. H. Braymer, who is co-editor of *Electrical World*, is editorial director of the new papers.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

AMERICAN RAILWAY ASSOCIATION: Historical Statement and Present Activities—New York: The Association. Paper; 6 x 9 in.; pp. 134; organization diagram.

The historical statement (10 pp.) covers the period 1872 to 1921. The matter on present activities summarizes the organization of the several divisions and their action as to rules and standards.

AMERICAN SOCIETY FOR TESTING MATERIALS: Proceedings for 1921—Cloth; pp. 1197; illustrated. $11.

ANNALI DEL CONSIGLIO SUPERIORE DELLE ACQUE, 1921—Fascicolo 2—Rome, Italy: Ministero dei Lavori Publici. Paper; 7 x 10 in.; pp. 154; illustrated; 10 lire.

Among other valuable material, contains a 32 pp. paper by Claudio Segre on delta foundation and sedimentation in artificial reservoirs; data on heavy rains in 1920; review of water legislation in Italy and elsewhere.

SURFACE WATER SUPPLY OF CANADA: Atlantic Drainage South of St. Lawrence River—For Climatic Years 1918-19 and 1919-20.—By K. H. Smith, M. E. I. C., District Chief Engineer, Ottawa, Ont.; Dominion Water Power Branch. Paper; 6½ x 9¾ in., pp. 144; map.

BUREAU OF MINES: Report for 1921—Washington, D. C.: The Bureau. Paper; 6 x 9 in.; pp. 133.

CANADIAN RECLAMATION SERVICE: Annual Report for 1920-21. Paper; 6 x 9 in.; folding map. Ottawa, Ont.

THE CITY PLAN OF HAMILTON, OHIO—By Harland Bartholomew, City Plan Engineer, St. Louis. Published by the Hamilton Chamber of Commerce. Paper; 8 x 11 in., pp. 66; illustrated.

CURRENCY INFLATION AND PUBLIC DEBTS: An Historical Sketch—By Edwin R. A. Seligman, Ph.D., LL.D., McVicar Professor of Political Economy, Columbia University. Prefatory note by Alvin W. Krech, President of the Equitable Trust Co. New York: Equitable Trust Co. Cloth; 6 x 9 in.; pp. 86.

Text, tabular data and bibliography by countries.

DESCRIPTIVE GEOMETRY—By George Young, Jr., Professor of Architecture, Cornell University, and Hubert Eugene Baxter, Assistant Professor of Architecture, Cornell University. New York: Macmillan Co. Cloth; 5 x 7¾ in.; pp. 310; illustrated.

THE DESIGN OF STEEL MILL BUILDINGS: The Calculation of Stresses in Framed Structures—By Milo S. Ketchum, Consulting Engineer; M. Am. Soc. C. E. Fourth Edition, Rewritten. New York and London: McGraw-Hill Book Co., Inc. Flexible; 6 x 9 in.; pp. 632; illustrated. $6 net postpaid.

ESSENTIALS OF INDUSTRIAL COSTING—By George Armstrong, C. E., M. E. New York and London: D. Appleton & Co. Cloth; 6 x 9 in.; pp. 297; illustrated. $5.00.

Deals clearly and concisely with principles and methods, chiefly by the case system. Has chapters on economics development and necessity, purpose and function, and mechanism of costing; elements and sources of costing data; material; labor; expense and its distribution; depreciation, interest and power; final costing; and connection of costing with the general books and monthly statements therefrom. The "illustrations" are in the nature of blank forms.

FIRE PREVENTION AND FIRE PROTECTION: As Applied to Building Construction—Second Edition, Revised. By John Kendall Freitag, B. S., C. E. New York: John Wiley & Sons. London: Chapman & Hall. Flexible; 4½ x 7. Pp. 1038; illustrated. $5.00.

FUNDAMENTALS OF ECONOMIC PLUMBING—By William Paul Gerhard, Consulting Sanitary Engineer, New York. From The American Architect—The Architectural Review, Dec. 21, 1921. Paper; 9 x 12 in.; pp. 4.

HYDRO-ELECTRIC DEPARTMENT OF TASMANIA. Report for 1920-21. Hobart, Tasmania. Paper; 8 x 13 in.; pp. 47; illustrated.

INDUSTRIAL OPPORTUNITIES IN NEW JERSEY—Trenton, N. J.: Department of Conservation and Development. Paper; 7½ x 10 in.; pp. 32; illustrated.

AN INVESTIGATION OF THE FATIGUE OF METALS—By H. F. Moore and J. B. Kommers. Urbana, Ill.: Engineering Experiment Station, University of Illinois. London: Chapman & Hall. Paper; 6 x 9 in. 95c.

An abstract of this bulletin appeared in *Engineering News-Record*, Jan. 12, 1922, p. 76.

IOWA ENGINEERING SOCIETY: Proceedings, Des Moines, Iowa: Lloyd A. Canfield, Secretary-Treasurer. Paper; 6 x 9 in.; pp. 207.

MAINE ASSOCIATION OF ENGINEERS: Proceedings, 1917-20—Bangor, Me.: The Association. Paper; 6 x 9 in.; pp. 128.

NATIONAL BRICK MANUFACTURERS ASSOCIATION—Proceedings, 1921. Indianapolis: T. A. Randall, Secretary, 211 Hudson St. Paper; 6 x 9 in.; pp. 216.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS: Reports, March 16, 1920, to Dec. 21, 1920—Trenton, N. J. Cloth; 6 x 9 in.; pp. 630.

PLUMBING FIXTURE TRAPS: An Historical, Statistical and Experimental Engineering Research on Vented and Unvented Traps—By A. E. Hansen, Hydraulic and Sanitary Engineer. New York City: The Author, 2 Rector St. Cloth; 7 x 9 in.; illustrated, $2.

THE PORT OF PORTLAND, MAINE—Port Series, No. 1. Prepared by The Statistical Division Board of Engineers for Rivers and Harbors, A. H. Ritter, Chief Statistician, Washington, D. C.: War Department, Corps of Engineers, U. S. Army. Paper; 6 x 9 in.; pp. 64; folding maps and tables.

The reports in the series here begun will describe port and harbor facilities for shipping, port charges, railroads, the local conditions of transfer between rail and water and also that of transportation between port and interior, other conditions governing the movement of traffic through the port and such additional information as may be of value to operators of vessels and to producers and manufacturers seeking the most economical outlet for their product. They will also show the facilities available for the handling and distribution of imports. Manifestly this is a most desirable line of work and it is to be hoped that the board will be able to continue its investigation in as worthy a way as it has already done in the case of Portland.

PRACTICAL ELECTRICITY FOR BEGINNERS—By George Willoughby, Shop Supervisor, Arthur Hill Trade School, Saginaw, Mich. Peoria, Ill.: Manual Arts Press. Cloth; 5½ x 8 in., pp. 101; illustrated. $1.

PRACTICAL LEAST SQUARES—By Ora Miner Leland, B. S., C. E. New York and London: McGraw Hill Book Co. Cloth, 6 x 9 in.; illustrated.

PRACTICAL STRUCTURAL DESIGN—Second Edition, Enlarged and Revised. By Ernest McCullough, C. E., Ph.D., New York: U. P. C. Book Co. Cloth; 6 x 9 in.; pp. 317; illustrated. $3.

The first edition of this elementary "practical" text and reference book was favorably reviewed by Walter S. Edge in *Engineering News-Record*, Jan. 17, 1918, p. 128. Besides correcting errors, this edition contains a new chapter on Semi-Rigid Frames.

PRINCIPLES OF RAILROAD TRANSPORTATION—By Emory R. Johnson, Ph.D., Sc. D. Dean of the Wharton School of Finance and Commerce and Professor of Transportation and Commerce in the University of Pennsylvania, Author of "Ocean and Inland Water Transportation," "Elements of Transportation," etc., and Thurman W. Van Metre, A. M., Ph. D., Associate Professor of Transportation in the School of Business of Columbia University, Author of "Economic History of the United States." New York and London: D. Appleton & Co. 6 x 9 in.; pp. 617; illustrated with half-tones, maps and diagrams.

The 1916 edition of this book was favorably noted in some detail in *Engineering News-Record*, Oct. 19, 1916, p. 748, and characterized as "devoted chiefly to the social, political and economic relations of the railway rather than to the physical features of its construction and operation." The book itself contains no intimation of the extent of the revision of 1921. The paper jacket speaks of an entire rewriting with the assistance of Prof. Van Metre, and of a new title, but this was true of the 1916 as compared with earlier editions. However, some fresher figures are apparent and there is a chapter on the 1920 Transportation Act.

PRODUCTION OF COAL AND COKE IN CANADA, 1920—Compiled by John Casey. Ottawa, Ont.: Department of Mines. Paper; 6½ x 9¾ in.; pp. 36.

REPORT OF THE CHIEF ENGINEERS, U. S. ARMY, 1920-21—Washington, D. C. Paper; 6 x 9 in.; pp. 2115.

SEWERAGE AND SEWAGE DISPOSAL: A Textbook—By Leonard Metcalf and Harrison P. Eddy. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 598; illustrated. $5.

SOME FACTORS IN THERMAL SANITATION IN THE TROPICS— By George Walter Grabham, M. A., F. G. S. From The Journal of Hygiene, Jan. 12, 1921. Cambridge, England: University Press. Chicago, Ill.: University of Chicago. Paper; 10 x 7 in.; pp. 30; illustrated. Single copies: 12½s. net; $2.50.

Deals with the heat absorbing properties of various materials and fabrics, and summarizes experiments on the translucency and porosity of materials used for clothing.

SOUTH AFRICAN RAILWAYS AND HARBORS: Report for 1920-21. Pretoria: Ministry of Railways and Harbors. Paper; 8¼ x 13 in.; pp. 147; illustrated.

Besides traffic and financial statistics this report discusses various phases of railway development: electrification, road motor service, grade and curve revision, preservative treatment of native woods, etc.; also harbor improvements. Several pages contain extracts from the reports of the chief civil and mechanical engineers.

STANDARD GENERAL SPECIFICATION FOR WIRE ROPE: Canadian Engineering Standards Association, Ottawa, Ont. Paper; 6 x 9 in.; pp. 16. 25c.

TASCHENBUCH FUR DAS EISENBAHN-TICHERUNGSWESEN—Von Behrens, Regierungs-und Baurat, Mitglied des Eisenbahn-Zentralamts, und Schubert, Eisenbahninspector, technischer Betriebs kontrolleur beim Eisenbahn-Zentralamt. Berlin: H. Apitz. Boards; 4½ x 7 in.; pp. 362; 50 marks.

TESTS OF ROAD MATERIALS OF INDIANA—Bulletin 7, Engineering Experiment Station. Prepared by the Staff of Laboratory for Testing Materials, Purdue University, Lafayette, Ind. Paper; 6 x 9 in.; pp. 54.

INTERSTATE COMMERCE COMMISSION: Report for 1920-21. Washington, D. C. Cloth; 6 x 9 in.; pp. 226.

UNITED STATES COAST AND GEODETIC SURVEY: Report for 1920-21. Washington, D. C. Cloth; 6 x 9 in.; pp. 141; illustrated.

UNITED STATES GEOLOGICAL SURVEY: Report for 1920-21. Washington, D. C. Paper; 6 x 9 in.; pp. 108.

VERMONT SOCIETY OF ENGINEERS: Proceedings, Sept. 27, 1921—Montpelier, Vt. Paper; 6 x 9 in.; pp. 16.

WATER POWER OF THE WORLD: Part II, World Atlas of Commercial Geology—Text by Herman Stabler, B. E. Jones, O. C. Merrill and N. C. Grover. Washington, D. C.: U. S. Geological Survey. Stiff Paper, Linen Back; 14 x 10½ in.; 36 pp. text, 10 full-page maps. $1.

Text and tables describe and summarize the world's water power by grand totals, by continents and by countries. One map shows altitudes and one mean annual precipitation for the two hemispheres. The other maps show by symbols the relative water power, (1) developed and (2) both developed and undeveloped for the two hemispheres, by continents and countries.

WHARF MANAGEMENT—Stevedoring and Storage—By Roy Roy S. MacElwee, Director of the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, and Thomas R. Taylor, Chief of the Latin-American Division, Bureau of Foreign and Domestic Commerce. [Shipping Series]. New York and London: D. Appleton & Co. Cloth; 6 x 9 in.; pp. 350; 94 line cut and half tone illustrations. $5.

WORLD ALMANAC AND ENCYCLOPEDIA—1922. New York Press Publishing Co. Paper; 5 x 7 in.; pp. 858. 35c.

HINTS FOR THE CONTRACTOR

Timber Lining in Canal Placed Rapidly With Aid of Jack Frames

IN RENEWING the timber lining of a 26 x 8-ft. canal on the White River development of the Puget Sound Power & Light Co., it was desirable to have the canal out of service as short a time as possible. The work was therefore planned to be carried out by four crews, one working each way from the center and one starting at either end. By creating a rivalry between the crews and developing interest in their relative daily progress, the work was completed in record time. Jack frames on wheels with which the walls could be held in position for the caps were important factors in the rapid progress.

As originally built, the lining was supported on pile bents driven 8 ft. apart with each floor sill gained into piles on opposite sides and resting at the mid point on top of a pile driven on the center line of the canal. The floor and side lining consisted of 3-in. fir planks spiked to sills and wall piling and with 1 x 4-in. battens over cracks.

On account of the alternate wetting and drying of the sides as the flow of water in the canal varied, the walls became badly rotted. In this condition there was danger during wet weather of water pressure building up on the outside and caving in the rotted walls. The sills, flooring and piling up to a point about 2 ft. above the floor, which is always wet, did not require renewal, being practically as sound as ever.

The new lining placed on the sides is 3-in. tongue-and-groove cedar placed upright inside the old walls. It is held at the top by a 6 x 8-in. cedar waling strip and at the bottom by a 3 x 10-in. cleat spiked to the floor sills with 12-in. boat spikes. The side lining was nailed at the top to the waling strips and after these were jacked out tight against the lining they were held in that position by 6 x 8-in. fir caps placed across the canal at 8-ft. intervals. The caps were gained to take the strips and were bolted to them.

For distributing material along the canal a small caterpillar tractor was used, hauling a train of three 28-ft. trucks along the canal bottom. The tractor could couple on either end of the train, thus eliminating the necessity for turning the train around. All materials were distributed before the work commenced.

For forcing the new lining out tight against the old, 15-ton ratchet jacks were used, mounted on frames carried on four wheels, as shown in the accompanying picture. These frames were easily moved and two men could move the 8 ft. from one cap to the next, jack the walls out, mark the cap, cut and creosote the gain, set the cap in place and be ready to move again, all in a period of five minutes.

Each crew consisted of about 19 men, all of whom were employed just for this job. The crew which excelled in placing caps put 108 of them in place in a day. Another crew lined 3,304 ft. of canal in one day.

The relining of 9,900 ft. of canal was completed in 5½ days at a total cost of about $36,000. The work was under the direction of A. P. Newberry and Fred Haase of the Puget Sound Power & Light Co.

RELINED CANAL WITH JACK FRAME IN FOREGROUND; CLOSE VIEW OF JACKING DEVICE
(Note springs for drawing back timbers when jack is released)

Bearings Have Critical Friction Load

AN INVESTIGATION of ball and roller bearings of rather large size recently made at the Bureau of Standards for the Navy Department shows that these bearings have critical loads beyond which their friction coefficients increase rather rapidly. For balls of 1, 1¼ and 1½ in. diameter, running in grooved races, the friction coefficient was about 0.00055 up to a critical load ranging from 1,300 lb. per ball for 1-in. to 2,200 lb. for 1½-in. balls. Helical ("flexible") rollers 1¼ in. in diameter by 5¼ in. long showed a similar critical load of 25,000 lb. total; below this load their friction coefficient was 0.00075. In every case the critical load determined on the basis of friction coefficient was considerably lower than the safe load as determined by permanent deformation. The deformability of balls, rollers and races was measured, and proved to be closely in accord with Hertz's theory. The investigation is summarized in the Bureau's Technologic Paper No. 201.

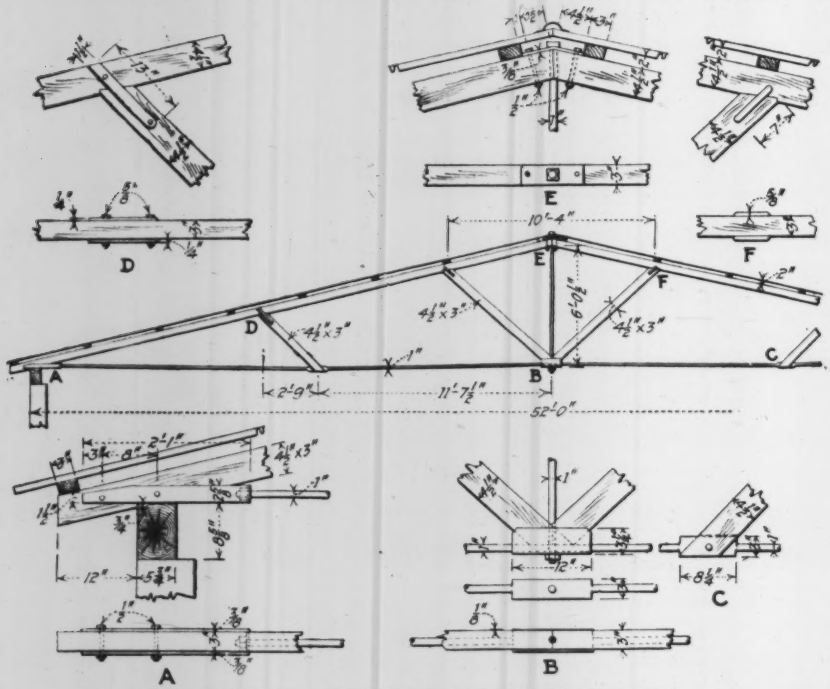
LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Amateur's Roof Truss Defies Fate

Sir—An unusual type of roof truss is shown in the accompanying drawing. The roof covering is of galvanized corrugated-iron sheets, and the trusses are more or less 8½ ft. on centers. The purlins, 2 in. deep, are unsupported between trusses.

"This building was not designed according to theory," the constructor informed the writer. I agreed with him. However, the building has stood now for more than eight years, and is but another of those examples which are so interesting as showing peculiar construction which serves its purpose.



THIS ROOF TRUSS HAS STOOD FOR EIGHT YEARS

NEWMAN TATE,
Chief Constructional Designer, Rio Tinto Mines.
Minas de Rio Tinto, Huelva, Spain, Dec. 1.

The Owner a Contributor to Building Corruption

Sir—In your issue of Jan. 5, 1922, p. 4, under the caption "Scandals in the Building Industry," you deplore the fact that contractors generally have not taken action to correct conditions. The Building Construction Employers Association of Chicago early last year through its legal action committee did employ a staff of investigators to run down and expose cases of graft and extortion and it was only because of the fact that the Dailey Commission started to function and it was thought that this committee with the power and authority of the State of Illinois behind it could do the work more effectively, that the employers association abandoned its program.

It is believed most of the scandals will be traced not to contractors, who generally have been given all of the discredit, but to owners who, working through their architects, have used the contractor as a means of corruption. The owner who considers his construction a special case which must be finished regardless of the effect on the industry, is undoubtedly the main cause for the deplorable conditions that have existed.

EDWARD HAUPT,
Chicago, Jan. 9. President, Building Construction Employers Association.

Concerning the Value of Reclaimed Cement

Sir—I note a very ingenious cement sack shaker described in *Engineering News-Record*, Dec. 29, p. 1075. Prominence is given to the fact that the cement saved is twice the value of the labor of shaking. A similar comparison has been noticed in the accounts of other cement sack shakers.

I am very curious to know if this salvaged cement is really fit to use. A few months ago I shook out a batch of bags by the old-fashioned method of beating them in the top of an empty barrel, and collected two large barrels of cement. I did not use this cement in the main body of the structure, as I doubted its value somewhat, but made up a batch of precast hand rail spindles with it, using a 1:2:3 mix, with a little extra cement to make up for what I imagined the loss in strength would be.

I was very much surprised to find out two days later that the concrete had set very little, and after four days, when the spindles should have been quite strong and ready for rubbing, I found that I could remove them from the forms only with very great care, and in fact most of them were broken in the removal. I discarded the whole batch before the engineer on the job saw them, but saved several spindles for several weeks. They hardened some in time, but never got hard enough really to be called concrete.

The point I am curious about is: How much value has this reclaimed cement? If it is considered good, and put back into new work, are we not taking chances? I would like to know the experience of other engineers. I have always used this reclaimed cement in small patchwork, but if my experience has been duplicated by others, it has very doubtful value even for this, and should be discarded altogether. There is a lot of this cement being used, if many men are saving as much as the man in the article quoted, and I would like to hear what the other engineers have to say on the subject.

C. T. DAWKINS,
Jacksonville, Fla., Dec. 31, 1921. General Contractor.

Recommend Nationalization of Water Resources

The British Water Power Resources Committee, which has been investigating available water power throughout Britain, has recommended that the entire water resources be nationalized and placed under the control of a water commission with certain specified powers. The Committee also finds that the total potential water power amounts to 250,000 kw. divided as follows: Scotland, 194,965 kw.; Wales, 35,900 kw.; and England, 20,440 kw. Of this amount 210,000 kw. could be developed economically. The generation of this power over one year would represent slightly under 40 per cent of the total units generated in the 410 steam power plants for electricity supplied railways and tramways.

NEWS OF THE WEEK

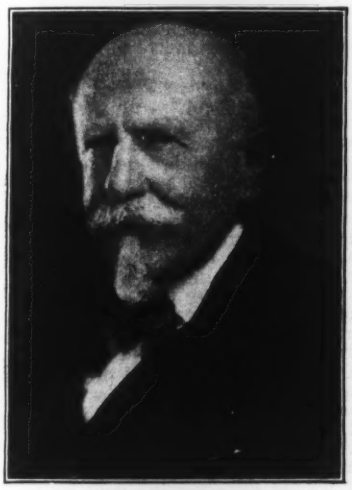
New York, January 19, 1922

John R. Freeman Elected Am. Soc. C. E. President

Internationally Known For Hydraulic Investigations — Has Been Vice-President and Director

Professional activities of John R. Freeman, new president of the American Society of Civil Engineers, have been international in character for many years. There are few members of the American Society of Civil Engineers, or the American Society of Mechanical Engineers (which organization he has also served in executive capacities) who are not familiar at least with Mr. Freeman's general professional career, particularly in the field of water supply and fire protection. He has been a prominent figure in the society for years, and served as

Elected President of Am. Soc. C. E.



John R. Freeman

a director in 1896-1898, and as vice president in 1902-1903. He has twice been awarded the Norman medal, once for a paper relating to the hydraulics of fire streams, and the other time for a paper on the nozzle as an accurate water meter. He has been a member of the society since 1889, though seven years prior to that date he was connected with it as a junior.

Mr. Freeman was born in West Bridgeton, Me., July 27, 1855. His early days were spent on the farm and his education was begun in the district school of that place. This education was supplemented by terms in the public schools of Portland, Me., and Lawrence, Mass. Later he entered the Massachusetts Institute of Technology, from which institution he was graduated in 1876. During his summers both in high school and college he was employed in various engineering capac-

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Am. Soc. C. E. Amendments Rejected By Meeting

Major Constitutional Changes Not Recommended, but Minor Changes Approved—Formal Presentation of Honorary Memberships

Recommendations adverse to the major constitutional amendments were voted by the annual meeting of the American Society of Civil Engineers, in New York on Jan. 18, though the minor amendments correcting certain obvious conflicts were favorably received. This action was the most important business transacted at the meeting, which was marked also by the formal presentation of certificates to the new honorary members. Canvass of ballots for 1922 officers showed that the ticket sent to letter ballot, headed by John R. Freeman, was elected almost unanimously. Announcements were made of the awards of the various medals and prizes bestowed annually by the society. A half dozen committees presented technical reports of progress.

An innovation which was well received as a substitute for the mere reading of names of new honorary members was the formal presentation of the five new honorary members just chosen. Each of these members was introduced separately by a member of the society chosen for the purpose and each of those present responded to the presentation of his membership certificate. In the case of the two foreign members elected responses were made by representatives of the French and Italian governments and for Mr. Carson the response was made by L. H. Davis. Biographical skektches of the five new honorary members are presented elsewhere in this section.

The annual report of the Board of Direction showed a total membership of the society on Jan. 1 of 10,342 and a net gain in membership for the year of 435. The financial reports of the society showed a balance on hand as of Dec. 31 of nearly $41,000.

New Work To Be Undertaken—According to action of the Board of Direction, as announced by President George S. Webster, several important new pieces of work are to be undertaken. A committee of seven is to cooperate in a study of regulations for fire protection of docks, wharves and piers. The society will be represented in a joint conference with the Red Cross Society on Flood Prevention. Victor H. Cochrane has been appointed on the bridge specification committee. President Webster will represent the society in a conference of societies on an International Engineering Congress to be held in Philadelphia in 1926.

Committee Reports

A brief summary of the committee reports presented follows. There was practically no discussion on any of the reports. In each case the report was accepted and the committee continued.

Bearing Value of Soils—R. A. Cummings, chairman, reported that the special committee appointed on To Codify Present Practice in Regard to Bearing Values of Soils for Foundations had been more active during the past year than previously, through the effect of an appropriation by the Board of Direction. Funds have been given to researches at Iowa State College, which promises to be the stepping stone to results of practical value. The strength of clays in their undisturbed natural condition has been measured, and a report of this work will be published as part of the committee's report. The recent literature of soil studies has been reviewed and the principal mathematical formulas brought together. A summary of these data together with reports on soil tests made at San Francisco and Seattle by local engineers will be appended to the published committee report.

Bridge Specifications — Reporting on the first year's work of this committee, H. B. Seaman described the distribution of the field to be covered among subcommittees of one each, dealing separately with highway loading and impact, railway loading and impact,

Highway Research Board Meets

Four New Committees Authorized to Round Out Board's Scope—More Money Needed

Approval of the appointment of four new committees, the adoption of a budget providing for expansion of its work, and a resolution to invite six new organizations to take membership were the important steps taken at the meeting of the Advisory Board on Highway Research in New York, January 16. The new committees are: On Highway Traffic Analysis, On Highway Bridges, On Highway Finance, On Maintenance. It was also proposed that the board invite the Committee on Sub-Grade, which formerly functioned under the Federal Highway Council, to identify itself with the board.

Reports on work done during the year indicated that the only vigorous activity has been that of the Committee on Economic Theory of Highway Improvements, under the chairmanship of Prof. T. R. Agg. The researches which it is following and trying to co-ordinate—though not all of them—were started as a result of the committee's activity. They are as follows: (1) economical highway grades at the Iowa Engineering Experiment Station; (2) active resistance of certain types of vehicles and surfaces, also at the Iowa station; (3) active resistance of vehicles on concrete road surfaces, including a study of methods of observation and of internal

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substructure and foundations, allowable unit stresses, shop and erection methods, reinforced-concrete structures, and materials. Railway bridge specifications were taken up as the first work, and a tentative specification was presented to the meeting, as a basis for general discussion by the members of the society. There are differences of opinion within the committee on many points of the specification, Mr. Seaman stated, and certain divergences in point of view have developed, especially with regard to the attitude to be taken toward the prior work of the American Railway Engineering Association in this field.

Track Stress Committee—No report of results was presented by the committee on Stresses in Railway Track, member of a joint committee of three societies on this subject. Prof. A. N. Talbot, chairman, reported that tests have been made on curved track, but the unexpectedly large amount of labor in reduction of the results made it impossible to report upon them at present. Tests have also been made in rail joints, to determine their manner of action and the stresses in joint bars and rails. Various further questions are under consideration. The committee was continued.

Standard Contract Clauses—In behalf of H. E. Breed, a progress report was presented by J. S. Langthorn, consisting chiefly of a summary of the proceedings of the conference on standardization held at Washington last December under the auspices of Secretary Hoover.

Highway Research

Highway Engineering — Similarly, Mr. Langthorn reported for Mr. Breed that this committee is devoting itself chiefly to the functioning and co-operation of the Federal Bureau of Roads and the state highway departments. The committee recommended that federal road appropriations be made $20,000 per mile, with an additional allowance of $10,000 per mile where there are special drainage or other difficulties to be met; that for interstate and national roads permanent types of pavements be adopted; and that Congress should be asked by the society to pass H. R. 8978 providing for a road appropriation of $100,000,000 a year for five years in the interest of comprehensive planning and construction. No action was taken on these recommendations.

Among the non-technical committees, the one on the proposed Alfred Noble Memorial reported conferences with Paul Bartlett, the sculptor, and Glenn Brown, the architect, on matters of design. On account of present high costs the committee is not pressing forward with plans for construction. Samuel Rea is chairman of this committee.

Awards of Society Medals and Prizes —The award of medals as recommended by the committee on awards and approved by the Board of Direction was as follows: Norman Medal, no award. J. James R. Croes Medal, to Fred A. Noetzli, Associate Member, for his paper on "Gravity and Arch Action in Curved Dams." The Thomas Fitch Rowland Price to Ernest E. Howard, Member, for his paper "Vertical Lift Bridges." The James Laurie Prize to W. C. Curd, Member, for his paper on "Bank Protection and Restoration; a Problem in Sedimentation." The Collingwood Prize for Juniors to L. Standish Hall for his paper on "The Probable Variations in the Yearly Run-Off as Determined from a Study of California Streams." Wellington Medal, no award.

Constitutional Amendments — Two groups of constitutional amendments were submitted, one proposed by the Executive Committee and legal counsel of the Society to clarify minor inconsistencies in the constitution, which was referred to letter ballot with favorable recommendation; and a second group designed to carry out various changes in the constitution as to the election of directors and as to sections of the Society that have been advocated from time to time in the past. The second group of amendments was also referred to letter ballot but with the recommendation of the meeting against the adoption of the amendments. This group of amendments gave rise to considerable spirited discussion, it being claimed by representatives outside of District No. 1 that something was very much needed to enlist the interest of the members in the other districts. Each of these amendments was voted on separately. When the final one of the group was acted upon a call for a division was made and the count of hands showed 207 votes in favor of the recommendation against the adoption and 36 votes the other way. A request was then made for a show of hands to indicate how many of these present from District No. 1 and how many from other districts. This vote was 223 to 150 but apparently many of those present did not vote.

New Officers—The official canvas for votes for officers showed a total of 2,116 legal votes. Nearly all of these in each case were in favor of the various officers on the ticket. The following were declared elected: President, John R. Freeman. Vice-Presidents, C. E. Grunsky and Robert Ridgway. Directors from District No. 1, C. M. Holland, and J. J. Yates; No. 2, F. E. Winsor; No. 6, J. N. Chester; No. 8, A. J. Dyer; No. 13, W. L. Huber.

President's Remarks

At the conclusion of the business session Mr. Freeman was escorted to the chair. On acknowledging his elevation to office he remarked that he had been a member of the society for about 40 years and that he thought he has gotten most benefit from the society while in the junior grade through the inspiration of the older members. He also said that he wished all could have heard the remarks made the previous evening at the meeting of past presidents of the society. These showed no discord and that all were looking ahead. The three main topics discussed were how more service could be rendered to distant members; how the interest of sections could be advanced and what could best be done for junior members.

62,000,000 Sq. Yd. Concrete Highway Laid in 1921

According to estimates made by the Portland Cement Association, there were laid during 1921, 62,000,000 sq.yd. of concrete highway pavement. This is equivalent to 6,000 miles of 18-ft. road of the average depth. This figure is also almost double that laid in the previous year.

Highway Research Board Meets

(Continued from P. 125)

power losses, at Massachusetts Institute of Technology, in co-operation with the Bureau of Public Roads, the Connecticut Highway Department, The Portland Cement Association, and Yale University; (4) active resistance in economical grades at the University of Michigan; (5) effect of relative airspeed at Kansas Agricultural College; (6) the establishing of the relation between traffic and maintenance cost by the Bureau of Public Roads.

Arrangements are complete or are pending for three additional researches: (1) On relation between roughness and rapidity of road surface and rolling resistance, at Iowa Engineering Experiment Station in co-operation with the Bureau of Public Roads; (2) Elements in cost of highway transport, by the Society of Automotive Engineers; (3) Operating costs of motor transport in and near Los Angeles.

The committees on Character and Use of Road Materials, under the chairmanship of H. S. Mattimore, and on Structural Design of Roads, under the chairmanship of A. T. Goldbeck, have not, because of various hampering conditions, been able to make much progress. The work of organizing the committees, however, is in hand, and in the case of the first one practically finished.

The budget for next year calls for an expenditure of $25,000, compared with $13,000 last year. The additional money is to be spent for an assistant to the director, for clerical services, for a census of highway research, and the preparation of a bibliography. However, these additional expenditures are contingent upon securing the additional funds. A ways and means committee will be appointed to secure the additional money needed. Money in sight this year is as follows: Bureau of Public Roads, $12,000; Connecticut Highway Department, $1,000; Engineering Foundation, $1,000; National Research Council, $500.

A resolution was passed pressing the board to urge upon Congress the increase of the administrator's allowance in the Federal Aid Road Act from 2½ to 3 per cent, with the understanding that the additional one-half of one per cent should be expended upon co-operative research between the Bureau of Public Works and the State Highway Department. Under this plan an additional million dollars would be available for research, provided future annual appropriations by the Government are $100,000,000, since the Bureau of Public Roads engages in these co-operative researches on a dollar for dollar expenditure basis.

It was resolved to invite the following organizations to take membership in the board: Associated General Contractors, Rubber Association, Western Society of Engineers, Eno Foundation, Chamber of Commerce of the U. S. A. and Bureau of Standards.

Officers for the ensuing year were elected as follows: Chairman, Anson Marston, of Iowa; vice-chairman, A. D. Flinn, of New York; Executive Committee, Prof. Comfort, A. Adams, of Boston, H. M. Crane, of New York, T. H. MacDonald, of Washington. Except in the case of Prof. Adams, these are re-elections. Dr. W. K. Hatt, continues as Director of Highway Research, though no action on that matter was required.

New Honorary Members, American Society of Civil Engineers

Samuel Rea

Almost continuously for more than half a century Samuel Rea, elected an honorary member of the American Society of Civil Engineers on June 6, 1921, has served the engineering division of the Pennsylvania R.R. Co. Mr. Rea entered the engineering department of the Pennsylvania **July 17, 1871,** as a chainman and rodman on the Morrison Cove Branch, and with the exception of being employed by the Hollidaysburg Iron & Nail Co. three years later, with the Maryland Central Ry. Co. in 1889 and an absence of three years' duration later, he has been in the employ of the Pennsylvania since his first connection with it. Mr. Rea has served in an executive and consulting capacity for the Pennsylvania in some of its largest construction enterprises, he was given direct charge of the construction of the double-track tunnels under the North River and the construction of the terminal in the heart of New York City, completed more than a decade ago.

Mr. Rea was born in Hollidaysburg, Pa., in 1855 and he began his engineering work at the age of sixteen years. After rejoining the company in 1875 he served as assistant engineer on various Pennsylvania projects and from 1879 to 1883 served as engineer in charge of surveys in Westmoreland County and of the rebuilding of the Western Pennsylvania R.R. In the latter year he was transferred to Philadelphia as assistant to one of the vice-presidents, with the title of principal assistant engineer, which he held until 1888 when he was made assistant to the second vice-president. This office he retained until 1889, when he resigned to go to Baltimore as vice-president of the Maryland Central Ry. Co. and chief engineer of the Baltimore Belt R.R.

In 1891 he resigned because of ill health and after an absence of three years from the Pennsylvania R.R. Co. rejoined it as assistant to the president in 1892. Successively he then served as first assistant to the president, fourth vice-president, third vice-president, second vice-president in charge of the engineering and accounting departments, and first vice-president. In 1912 Mr. Rea was elected president of the Pennsylvania R.R. Co.

Mr. Rea is a member of various New York and Philadelphia clubs, besides being a member of the Institution of Civil Engineers and various patriotic organizations.

Charles Prosper Eugene Schneider

Charles Prosper Eugene Schneider, elected to honorary membership in the American Society of Civil Engineers on Oct. 10, 1921, is known throughout Europe as well as in this country for his connection with the development of various ordnance including the 75-mm. rapid fire guns used in the World War. The war materials delivered by his factory (the Creusot Works, France) in large quantities during the war to the French and Allied government were of the most varied types.

Mr. Schneider was born at Le Creusot, France, Oct. 29, 1868, and is a grandson of the founder of the machine shops at that place where the development of the war materials for which he has become noted took place.

Mr. Schneider visited the United States during 1919, coming as chairman of the French Economic Commission in the interest of a closer cooperation between France and the United States. In recognition of his World War work, the Mining and Metallugical Society of America presented Mr. Schneider in 1919 with its gold medal.

Mr. Schneider is past president of the Iron & Steel Institute of Great Britain and honorary president of the Comité Des Forges of France.

Howard Adams Carson

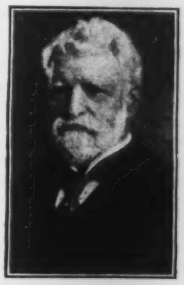
The professional career of Howard Adams Carson, elected an honorary member of the American Society of Civil Engineers on October 10, 1921, has been mainly identified with the engineering development of Boston and its vicinity. Outstanding projects with which he has been connected as chief engineer are the Metropolitan Sewerage Commission for Boston, where he designed and had complete charge of the construction of that system; and the Boston Transit Commission, where he superintended the design and construction of the original Boston subway opened to traffic in 1897. He has been consulted frequently concerning engineering projects, particularly pertaining to tunnel construction, and was one of a board of three who designed and built the double-track tunnel under the Detroit River for the New York Central Lines. He was also consulted concerning the New York and the Philadelphia subways.

Mr. Carson was born in 1842 and when in high school joined a battalion of United States engineers of the regular army and served throughout the Civil War.

He was graduated in 1869 from the Massachusetts Institute of Technology and has kept up a live association with that institution practically since. His professional career began in 1870, when he was appointed assistant engineer for a coal mining and iron manufacturing company in Western Pennsylvania. The next year he was appointed assistant engineer on the construction of the Providence water-works and in 1873 was placed in charge of the construction of the Providence sewers. In 1877-78 he spent his time in Europe studying various sewerage systems and in 1878 was appointed principal superintendent of construction of the Boston main drainage. Ten years later he made the design for the North Metropolitan and Charles River Valley Sewerage System for the State Board of Health of Massachusetts.

He is a member of the Institution of Civil Engineers of Great Britain.

Ambrose Swasey



Ambrose Swasey, elected to honorary membership in the American Society of Civil Engineers on June 6, 1921, has achieved an international reputation through his research work in connection with the production of astronomical instruments of precision. Besides his various technical contributions to the engineering world, Mr. Swasey made the initial gift which established The Engineering Foundation.

Mr. Swasey was born in 1846 in Exeter, N. H., where he gained his early schooling. He learned the machinists' trade in his native town and in 1870 entered the employ of the Pratt & Whitney Co., machinery manufacturers, at Hartford, Conn. In 1880 he went to Cleveland, Ohio, and entered into partnership with W. R. Warner, under the firm name of Warner & Swasey.

Mr. Swasey is an organizing member, past president, and honorary member of the American Society of Mechanical Engineers; past president and honorary member of the Cleveland Engineering Society; past president of the Cleveland Chamber of Commerce; a member of the American Philosophical Society, the Union Club of Cleveland and the Engineers Club of New York.

In 1900 the French Republic made him a Chevalier of the Legion of Honor.

Luigi Luiggi

For more than a third of a century, Luigi Luiggi, elected an honorary member of the American Society of Civil Engineers Oct. 10, 1921, has been prominently identified with the construction of maritime works of Italy. His reputation in the field of maritime engineering has led to his being engaged by both Argentine and Uruguay in a consulting capacity.

Mr. Luiggi was born in Genoa, Italy, in 1856. In 1875 he was graduated from the University of Genoa with a degree of doctor of physics and mathematics. In 1878 he was graduated from the Royal College for Civil engineers with a degree of civil engineer. The following year he became a cadet in the Italian Royal Artillery, Coast Defenses, and in 1880 was appointed member of the Royal Corps of Civil Engineers of Italy.

After there had been successfully completed under his direction several important works at Genoa, he was given the position of engineer-in-chief, Royal Corps of Civil Engineers, and appointed private technical adviser to the Minister of Public Works at Rome. In 1894 he acted as engineer-in-chief at Leghorn, Italy, for all maritime work in the Tuscan and Roman provinces.

He is professor of hydraulic engineeding in the University of Rome and a member of the International Technical Committee for the Suez Canal. He served during the world war as colonel in the artillery corps of the Italian army and was decorated by the Minister of Munitions for distinguished service.

Joint Commission Approves St. Lawrence Scheme

Recommends Early Construction of Following General Plan of Wooten-Bowden Report

The report of the International Joint Commission recommended the navigation and power development of the St. Lawrence was transmitted without comment by President Harding to Congress on Jan. 17. In brief the specific recommendations are as follows:

"1. That the Governments of the United States and Canada enter into an arrangement by way of treaty for a scheme of improvement of the St. Lawrence River between Montreal and Lake Ontario.

"2. That the new Welland Ship Canal be embodied in said scheme and treated as a part thereof.

"3. That the proposed works between Montreal and Lake Ontario be based upon the report of the engineering board accompanying this report, but that before any final decision is reached, the report of the board, together with such comments, criticisms and alternative plans as have been filed with the commission, be referred back to the board, enlarged by other leading members of the engineering profession, to the end that the whole question be given that further and complete study that its magnitude and importance demand, and that after completion the administrative features of this improvement be carried out as set forth in recommendations 7 and 8 hereof.

"4. That there shall be an exhaustive investigation of the extent and character of the damage through flowage involved in the plan of development finally adopted.

BOUNDARY CHANGES PLANNED

"5. That, assuming the adoption of the plan of the Engineering Board, or of other plans also, involving a readjustment of the international boundary, in order to bring each of the power houses on its own side of the boundary, appropriate steps be taken to transfer to one country or the other, as the case may be, the slight acreage of submerged land involved.

"6. That Canada proceed with the works necessary for the completion of said new Welland Ship Canal in accordance with the plans already decided upon by that country.

"7. That such 'navigation works' as do not lie wholly within one country or are not capable of economic and efficient construction, maintenance and operation within one country, as complete and independent units, be maintained and operated by a board hereinafter called the 'International Board,' on which each country shall have equal representation.

"8. That such navigation works as lie wholly within one country, and are capable of economic and efficient construction, maintenance and operation as complete and independent units, be maintained and operated by the country in which they are located, with the right of inspection by the said International Board, to insure economy and efficiency.

"9. That power works be built, installed and operated by and at the expense of the country in which they are located.

"10. That, except as set forth in recommendation 11, the cost of all navigation works be apportioned between the two countries on the basis of the benefits each will receive from the new waterway. Provided that during the period ending five years after completion of the works—and to be known as the construction period—the ratio fixing the amount chargeable to each country shall be determined upon by certain known factors, such as the developed resources and foreign and coastwise trade of each country within the territory economically tributary to the proposed waterway, and that that ratio shall be adjusted every five years thereafter and based upon the freight tonnage of each country actually using the waterway during the previous five-year period.

"11. That the cost of navigation works for the combined use of navigation and power over and above the cost of works necessary for navigation alone should be apportioned equally between the two.

John R. Freeman

(*Continued from p. 125*)

ities with the Lawrence Water Power Co. After graduation he joined the staff of the company regularly and soon rose to the position of principal assistant to Hiram F. Mills, chief engineer.

Increased responsibilities were placed upon him by his employer and after a few years he undertook engineering design on his own responsibility. The fact that he had charge of daily measurements of the water power used by the Lawrence factories and of water-power measurements for the factories in Manchester, N. H., gave him the intimate knowledge of stream flow and of gaging which has proved of much value to him. After ten years' experience, he opened a consulting office in Boston.

ENTERS INSURANCE FIELD

While this step was being considered he accepted the offer of the Factory Mutual Fire Insurance Co. to be its inspector and hydraulic engineer. Thus was his entry into the insurance field in which he has remained since, although not to the exclusion of other business and engineering enterprise. In such work his experiments on the discharge of fire nozzles and the hydraulics of fire streams came to be accepted as standards in that field of engineering investigation. Mr. Freeman sought particularly to perfect standard methods and appliances for fire protection and to unite manufacturers of fire appliances on certain standards of quality while preserving to each his individuality of detail. The specifications almost universally adopted for underwriter fire pumps underwriter nozzels, fire hose and the like, were drawn up by him after much experimental work.

Such investigations and activities led to his being made president and treasurer of the Manufacturers', Rhode Island and Mechanics Mutual Fire Insurance Co. in 1896, and several years later he was put in charge of fire protection and insurance interests of propty valued at more than $300,000,000, making his office the largest of its kind.

In his consulting capacities, he served well the New York Board of Water Supply, being appointed not only its first consulting engineer, but its first employee. One of his outstanding achievements was his report upon the water-supply resources of New York City in 1899, being selected by comptroller Coler of New York as an engineer familiar with large water supplies and unbiased by local prejudice. The request to submit such a report was received by Mr. Freeman in August, 1899, and the report was handed to Mr. Coler seven months later. In its printed form it was a book containing about 600 pages largely illustrated and was generally acknowledged to be the most elaborate water-works report ever prepared by one engineer.

Hardly less interesting as a piece of engineering literature is his report submitted as chief engineer of the committee appointed in 1901 to consider the advisability of constructing a dam across the tidal estuary of the Charles River between Boston and Cambridge for forming a large water park. The report of these studies was a book also of about 600 pages, invaluable to engineers who desire to investigate the subject of such work for improving the condition of tidal inlets. A further water-works achievement was his connection with the joint investigation made for the additional water supply for the City of New York.

Mr. Freeman has also served in a consulting capacity for various cities scattered all over the United States. His foreign activities have carried him to China and elsewhere. His most recent foreign work was consultant in the modernization of the grand canal in China. For a number of years he served as consulting engineer with the Board of Water Supply of the City of New York, (having been appointed to that position in 1905) and also has been engaged as consultant on water-power investigations for the New York State Water Supply Commission, on the Isthmian Canal lock and dam and on the San Francisco water supply, etc.

Besides being a member of the American Society of Civil Engineers, and the American Society of Mechanical Engineers, he is a member of the Boston Society of Civil Engineers and numerous other engineering organizations. He maintains a consulting office in Providence, R. I., and is president of the Manufacturers' Mutual Fire Insurance Co., of that city.

Consulting Engineers Hold Annual Meeting

Following a dinner at which were present 36 out of the 111 members, the Institute of Consulting Engineers held its annual meeting in New York on Jan. 16. Edwin Ludlow, Nicholas S. Hill and W. W. Colpitts were elected to the council, which elects the officers.

It was announced that the United Engineering Societies had accepted the Institute's offer to place in the Engineering Societies' Building in New York a bas-relief of Alfred Noble. Some discussion was offered on the situation regarding income taxes on consulting engineers' fees from states and municipalities, which is confused at present and a movement started toward a concerted action by those interested. Two cases of ethics were considered. The meeting approved a new clause declaring it unethical for an engineer "to submit proposals for or enter into contract for constructing works, plans and specifications for which have been prepared by him as professional engineer." The second case involved the right of an engineer to data developed in preparing a report or design for a client. Both cases will be stated more in detail in a later issue. It was also voted to add to the code of ethics a clause stating it to be unethical for an engineer "to publicly advertise his professional business in conspicuous places or with self-laudatory display."

Civil Engineers Discuss Traffic Handling

Many Remedies Proposed for Extreme Vehicular Congestion in Metropolitan Centers

Continuous movement of vehicular traffic by "platoons" was offered by Ernest P. Goodrich, consulting engineer, New York City, at the meeting of the New York Section, American Society of Civil Engineers, Jan. 11, as a means of relieving congestion on New York City's principal thoroughfares. The plan, which Mr. Goodrich maintains would simplify the problem of handling traffic on Fifth Ave. and crosstown streets, involves the passage of vehicles in groups, with considerable intervals between each pair, thus leaving open spaces for the passage of similar "platoons" of traffic moving in a direction at right angles to the first group. Under the platoon system of traffic regulation the arrangement would be similar to that of a regiment of soldiers formed into companies with spaces between each two companies. The advantages of such a scheme, Mr. Goodrich pointed out, lie principally in the fact that it would not stop traffic at regular intervals, as is the practice now on Fifth Ave. with the block and signal system. The platoons of traffic would keep continuously in motion and their speed would be regulated by a semaphore system of some sort.

Other Traffic Suggestions

Amos Schaeffer, consulting engineer to the borough president of Manhattan, read a paper dealing with an analysis of New York traffic conditions and desirable measures of relief for the present congestion. Among other things he suggested the elimination of the grade crossing at 42nd St. and Fifth Ave. by depressing the 42nd St. street car tracks and vehicular roadway, provision being made also for underground sidewalks at this point. A plan also was advanced for the removal of certain street car tracks at the intersection of 34th St., Sixth Ave. and Broadway.

In street improvements, Mr. Schaeffer stated, the movement of motor vehicles is being facilitated by the adoption at corners of curb radii of 12 ft., instead of the 6-ft. radius formerly used. Elevated railway columns on streets offer great obstructions to traffic movement, according to Mr. Schaeffer. A roadway with a width of 60 ft. would formerly accommodate four lines of vehicular traffic outside of the car tracks if it had no elevated columns, but with such columns, Mr. Schaeffer said, space for only two lines of vehicles is available. Referring to the influence of pavement types on vehicular traffic, Mr. Schaeffer announced that sheet asphalt and granite block were the prevailing types in the Borough of Manhattan. He predicted that the use of modern smooth, granite block pavements would increase and would be acceptable to all kinds of traffic.

Robert Grier Cooke, president of the Fifth Ave. Association, presented the traffic problem from the point of view of the merchant and endorsed the block signal system now in use on Fifth Ave. He believes that some time in the future it may be necessary to limit the number of buses using the avenue.

In New York's traffic squad of the Police Department, according to Inspector John F. O'Brien, there are now 1,547 men. The Police Department has under consideration plans for synchronizing the movement of traffic throughout the entire city by means of the block system and colored lights displayed from towers. Inspector O'Brien pointed out that the left-hand turn is one of the greatest obstacles in facilitating rapid movement of traffic. He explained in detail the Police Department's experiments in traffic handling on Fifth Ave. and in the theatrical district between Times Square and Columbus Circle.

Clifford M. Holland, chief engineer, New York-New Jersey Vehicular Tunnel Commissions, defended the use of a 20-ft. roadway in the tubes, explaining that a provision for greater widths would have increased the cost of the vehicular tunnel beyond all reasonable proportions.

The meeting closed with a discussion of street-car traffic in Newark, N. J., by A. T. Warner of the Public Service Railway Co., Newark, N. J.

Prof. Jacoby to Retire in June

Prof. Henry S. Jacoby, who for thirty-one years has been a member of the faculty of the College of Civil Engineering, more recently the College of Engineering, at Cornell University, will retire at the close of the college year from active duty, having reached the age specified for retirement. Prof. Jacoby for the past twenty-one years has been full professor and head of the Department of Bridge Engineering in the university. He has been unusually active in text-book writing, particularly in collaboration with Prof. Merriman of Lehigh University in their well-known text on bridges, and with Prof. Davis on foundations. It is announced that he will spend a year in travel and then will make his home at Bethlehem, Pa., which is in the vicinity of his early home and of his Alma Mater, Lehigh University.

Couzens Opposes Rapid Transit for Detroit

In a statement issued recently Mayor Couzens of Detroit said that subway or elevated rapid-transit lines are not needed in Detroit. A properly developed rapid-transit system for the city, he says, would cost $100,000,000, and a good part of this sum would have to be put on the tax roll, as fares would not pay the current charges. He suggests that the demand for rapid-transit subways springs from a desire for luxury rather than from the pressure of necessity, and remarks, "Communities are like people; every once in a while they get the idea that they must have certain things to satisfy their ego. A man makes $100,000 one year and thinks he must have a yacht, three limousines, and a palace in Florida, or a workman makes more money than ever before and must have a player piano and an automomobile. Detroit is that way about a rapid-transit system."

Federal Map Board Meets

The Board of Surveys and Maps of the federal government met on Jan. 10 to discuss technical standards regarding a change in scale of topographic maps and technical standards on the subject of "Map Projections."

Engineers Club of Baltimore Opposes Licensing

The Engineers Club of Baltimore went on record at a largely attended business meeting held January 5, as strongly opposed to any form of state legislation requiring the registration or licensing of professional engineers in the state of Maryland.

A bill prepared by a committee composed of a few practicing engineers of the city, for enactment by the state legislature now in session, was not only repudiated by a vote of the club after spirited debate, but the club voted opposition to any bill requiring state registration of professional engineers. The meeting was of a very representative character including local members of the American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Society of Civil Engineers, American Chemical Society, American Association of Engineers, and other engineering bodies.

The bill was strongly supported by some of the practicing engineers of Baltimore who claimed that they had been embarrassed in getting business in some of the fourteen states which have license laws for engineers, and they urged that Maryland have such a license law that they might secure reciprocal benefits. Opponents of state licensing of engineers urged that, because the public and the engineers of fourteen states were so unfortunate as to have license laws deemed detrimental to the best interest of both the engineer and the public of such states, was no reason for Maryland following in the wake; but that the Maryland engineer might better lend encouragement and assistance towards the repeal, if it were possible, of such laws in some of those fourteen states.

The supporters of the bill claimed that the enactment of the bill would elevate the standing of the engineer, would tend to get for the engineer greater compensation for his services, and would better protect the public. The opponents of the bill, while conceding it would be an excellent thing if it were practically possible for any board to sort and grade and record each engineer according to true qualifications and ability, asserted that engineering work and endeavor was as broad as the universe, not a limited field of endeavor as in law or medicine or dentistry; but more varied and diversified by far than any other profession; and thus it was not to be expected that any state appointed board could possibly handle the proper grading and restricting of the individual engineers.

Take Traffic Census to Decide on Grade Crossing Elimination

A traffic census is being taken at Ebensburg, Pa., at an existing railroad grade crossing to determine the method of elimination to be adopted. The Maple St. grade crossing is to be eliminated, and the local residents want a bridge constructed at a cost of $300,000, while the county thinks it sufficient to construct a subway for pedestrians and to divert vehicle traffic to another crossing. H. F. Dorr, county engineer, is therefore having a traffic census carried on to determine how much use is made of the crossing, on the basis of which it can be decided whether vehicle traffic should be diverted or provided for at this crossing.

Florida Road Bonds Bring Premium

With reference to the statement in this journal, Dec. 22, p. 1037, regarding the difficulty of disposing of $5,000,000 worth of road bonds in Florida, the following statement has been received from W. B. Powell, secretary of the Lake County (Fla.) Chamber of Commerce.

"This article does an injustice to Lake County and also the State of Florida. I have not the figures at hand for other counties, but bonds have been fetching premiums right along—Orange County adjoining Lake just sold part of $2,500,000 issue at par and accrued interest, and $15,000 premium on $750,000."

Included in Mr. Powell's letter was a clipping indicating that the $600,000 Lake County issue had been sold on Dec. 28, 1921, for a total of $601,500.

This journal has also received from the county engineer of Escambia County, Florida, the following information:

"The voters of Escambia County authorized the issue of $2,000,000 at 6 per cent, 30-year serial bonds on Sept. 29, 1920. Bids on $1,000,000 of these bonds were first received Nov. 15, 1921, but not being satisfied with the offers received, the county commissioners readvertised for Dec. 17, 1921. Lively bidding resulted and the $1,000,000 bonds sold for par plus a premium of $21,651."

Florida's Road Program for 1922

The Florida State Road Department's 1922 program four major projects enumerated by Judge H. B. Phillips, chairman, at a meeting Jan. 5. These projects are state road No. 2 from Lake City north to the Georgia line and south to Fort Myers; state road No. 4 from Jacksonville to Miami; the Kissimmee-Melbourne short cut between Tampa and Miami; and the Jacksonville-Lake City road. Bids were opened recently for the last four sections of the latter road, the total of the four projects, 42 miles in all, to cost $942,000, according to the lowest bid for a 6-in. concrete road, 16 ft. wide.

Louisiana Gasoline Tax Effective

The gasoline tax of 1 cent per gallon, which is expected to yield in the neighborhood of $1,000,000 yearly for road building purposes, became effective in Louisiana, Jan. 1, 1922. The tax will be collected from manufacturers and wholesalers on the basis of the previous month's sales. The exception to this general method of collection will be small filling stations along the borders of the state where gasoline is brought in wholesale quantities from Mississippi, Arkansas and Texas.

Indianapolis Sanitary Board Now Headed by Engineers

The Board of Sanitary Commissioners of Indianapolis, which has charge of building sewage-works and of the collection and disposal of garbage and refuse, has been reorganized. Jay A. Craven, an engineer member who has been secretary of the commission, is now president. John L. Elliott, recently appointed city engineer of Indianapolis and also to membership on the board, is now vice-president of the board.

"Engineering News" Is Gen. Kuhn's Xmas Gift to 3rd Engineers

The Third Engineer Regiment, U. S. Army, stationad at Schofield Barracks, Honolulu, received from Brig.-Gen. Joseph E. Kuhn, commander of the Hawaiian Division of the Army and formerly an officer of the Corps of Engineers, a Christmas gift in the form of a set of bound volumes of *Engineering News* covering the period from 1888 to 1911 inclusive. For the Third Engineers the gift was received by Col. Thomas Rees, the regimental commander.

Road Expenditures for 1922 Placed at $800,000,000

With the passage recently of the Federal Aid Highway Act it has been estimated by M. O. Eldridge, of the Good Roads Board of the American Automobile Association that during the calendar year 1922 there will be expended on public roads in the United States approximately $800,000,000. On the basis of $3 per day and 200 working days for each individual this would mean the employment of about 1,000,000 men in the building of roads and bridges and in the manufacture of road-building machinery.

It is also estimated by Mr. Eldridge that during 1922 at least $600,000,000 will be expended on city street paving, involving the employment of 750,000 laborers.

Heavy Rains Damage Structures in Southern California

As the result of unprecedented December rains highways were subjected to considerable damage in southern California. In San Diego, F. A. Rhodes, city engineer, reports the loss of the Rose Canyon bridge, a 20-ft. wood pile structure, cost to replace, $1,000; Sorrento bridge, same type and same cost; approaches to the Torrey Pines bridge, taking out about 60 ft. of concrete pavement, cost to replace, $3.000. Outside the city the county highways were bady washed in places, and on the Mussey Grade contract, held by Cook & Henno of Los Angeles, practically all the work done during the two months previous was washed out to bed-rock, this covering some 2 miles of work. A small bridge at the Mussey Grade also went out.

City May Purchase Light and Water Plants

Orlando, Fla., will vote Feb. 14 on a bond issue that includes $975,000 for the purchase and rehabilitation of the electric-lighting plant and waterworks now owned by the Orlando Light and Water Co. The price was arrived at by arbitration after both sides had secured estimates from engineers, varying as much as $500,000.

Of the bonds issued, $670,000 will be to purchase the two plants with about $150,000 each for rehabilitation, increasing production and extending the systems. The citizens will vote also on $340,000 for a sewer system.

Standard Specifications for Pressure Water Filters

The adoption of standard specification requirements for pressure water filters for various services is to come up at the annual meeting of the Associated Manufacturers of Water Purifying Equipment, which will be held at the Bellevue-Stratford Hotel, Philadelphia, Feb. 7. The association named includes in its membership nearly all the builders of water purification apparatus. M. F. Newman of Wm. B. Scaife & Sons Co., Oakmont, Pa., is president of the organization named above and heads its Committee on Standardization of Filter Sizes.

Practising Engineers Conference Arranged by A.A.E.

The American Association of Engineers will hold a conference of practising engineers at the Congress Hotel Chicago Feb. 22, Washington's Birthday. The tentative program includes the following subjects:

How to sell engineering service; experience of the practising engineer with licensing, (a) state reciprocity, and (b) licensing of engineering corporations; publicity for practising engineers; cost accounting for engineering service; bookkeeping for an engineering office; how to uphold the standards of services and fees; amendment of schedules of services and fees, (a) providing for other branches, such as mining and mechanical, and (b) to fit them to the practise appertaining to the several parts of the country; computing the practising engineer's income tax.

The conference will be in charge of the Committee on Services and Fees of Practising Engineers of the association, which consists of Langdon Pearse, chairman, Harvey N. Payne, Arthur Mullergren, Robert I. Randolph, C. T. Emrich, John W. Cunningham, George W. Fuller, Frank T. Payne, C. W. Hubbell, Brooks Baker, H. P. Letton, E. B. Latham, S. D. Foster and Frederick J. Amweg.

An invitation to attend the conference is extended to all practising engineers, whether members of the association or not.

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Convention, Cleveland, Ohio, Feb. 13-16.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 14-16.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 24-25.

AMERICAN WOOD PRESERVERS' ASSOCIATION, Baltimore; Annual convention, Chicago, Jan. 24-26.

The Great Falls Engineering Society has recently been organized with 40 charter members at Great Falls, Mont. The officers are: E. T. Harlow, president and John S. Roth, secretary-treasurer.

The Society of Industrial Engineers, a member of the Federated Engineering Societies, has elected Joseph W.

Roe, head of the industrial engineering department of New York University, as president, succeeding L. W. Wallace, secretary of the American Engineering Council. W. G. Sheehan, of Detroit, has been elected secretary and F. C. Schwedtman of the National City Bank, New York, treasurer.

The North Dakota Society of Engineers will hold its 14th annual meeting at Jamestown, No. Dak., on Feb. 8 and 9. The secretary is E. F. Chandler, University of No. Dak.

The New York Post, American Society of Military Engineers, will hold its annual meeting, election of officers and dinner on Jan. 25. Final arrangements have not yet been made. For further information address Percy E. Barbour, secretary.

The Engineers Society of St. Paul elected the following officers at the annual meeting, Jan. 9: president, W. W. Walker; vice-president, D. W. Flowers; secretary-treasurer, G. H. Wilsey.

The Ohio Engineering Society will hold its annual meeting at the Engineers Club in the Southern Hotel at Columbus, Ohio, Jan. 25-26. Secretary, John Graham, Columbus.

The Michigan Engineering Society (Michigan Assembly of A. A. E.) will hold its annual meeting at Kalamazoo, Michigan Feb. 8 to 10.

The Engineering Society of Wisconsin will hold its annual meeting Feb. 24-25 at Madison, Wis. Secretary, L. E. Smith, Madison.

The Western Society of Engineers, at its meeting on Jan. 9, listened to a paper on the concrete arch viaduct at Akron, Ohio, by Louis R. Ash, consulting engineer, Kansas City, Mo. In the construction work, which was described by the contractor, J. O. Heyworth, Chicago, special difficulties were the shortage of labor, the design of an economical arch form, and the necessity of carrying out the work on a narrow right-of-way.

The Indianapolis Chapter, A.A.E. held a meeting recently at which C. E. Drayer of Chicago, secretary of the national association, spoke on the accomplishments of the organization. He said that during the past year the A.A.E. has obtained positions for 3,000 engineers and is responsible for salary increases amounting to more than $9,000,000.

PERSONAL NOTES

J. H. FRANTZ, head of the Columbus, Ohio, branch office of the American Rolling Mill Co., has been elected president of the Ohio Manufacturers Association by the board of directors.

RICHARD C. HALDEMAN has been elected president and John D. Spong secretary-treasurer of the Harrisburg Bridge Co.

W. B. WACHTLER, until recently manager of the Chicago district for the industrial bearings division, Hyatt Roller Bearing Co., has been promoted and transferred to the New York headquarters as engineer in charge of general application.

D. V. WILLIAMSON, formerly secretary-treasurer of the Williamson-Webb Co., sales engineers, Detroit, Mich., has been made sales engineer of the American Manganese Bronze Co., Holmesburg, Pa.

WILLIAM C. FRANK, assistant chief engineer of the Cambria Steel Co., Johnstown, Pa., has been made chief engineer, succeeding the Late F. H. Meyer.

ARTHUR B. ROBERTS, consulting engineer, Cleveland, Ohio, has been appointed director of public works by Mayor Kohler.

$3,500,000 *Railroad Contract Let*

The Ontario government has awarded the contract for the extension of the Timiskaming & Northern Ontario Ry. 70 miles northward from Cochrane, to Grant, Smith & Co. and Macdonell, Ltd. of Vancouver, B. C. The price has not been made public but is stated by Premier Dewey to be within the estimate of $3,500,000. Work is to begin at once to afford relief to the unemployed. The first stretch of the road from Cochrane for 43 miles to the second crossing of the Abitibi River must be completed by the fall of 1923, and the whole extension finished within two years.

DAVID M. EARLE, city engineer, of Worcester, Mass., has been reappointed by the common council.

THOMAS COYNE has been reappointed superintendent of streets, Marlboro, Mass.

ASHTON D. PEACE, chief engineer for the General Iron & Steel Co., Paxtang, Pa., has been elected president of the common council of Paxtang Borough.

LEWIS R. OWEN and J. LEE PLUMMER, Johnstown, Pa., were elected engineers for the boroughs of South Fork, Seward, Berlin and Brownstown.

O. P. THOMAS, Johnstown, Pa., has been elected borough engineer of Conemaugh, Pa.

J. I. COLONY has been elected borough engineer of Renovo, Pa.

GEORGE C. HALCOTT, who has been superintendent of public buildings in Worcester, Mass., for many years, has been re-elected by the common council.

CLAUDE B. BOYNTON, formerly construction engineer with the Anaconda Copper Mining Co., Great Falls, Mont., is now in charge of construction work for the Forest Lawn Memorial Park Association, Los Angeles, Cal.

LUTHER K. ZERBE, former superintendent of streets, Canton, Ohio, has left the city to practise civil engineering for himself.

W. E. CARVER has been appointed city engineer and JOHN A. GUILEY, construction engineer, of Canton, Ohio. Both appointments are due to the reorganization of the city engineering department.

B. H. DAVIS, city engineer, Iowa City, Ia., has been reappointed for one year.

BUSINESS NOTES

CHARLES R. ROBINSON has accepted the vice-presidency of the Inland Steel Co. His headquarters will be in Chicago, but he will retain offices for the Niagara Metal Stamping Co. in Buffalo.

L. F. PIPER has been made manager of the recently-established branch of the J. W. Bishop Co., general contractors, in Bridgeport, Conn. Mr. Piper has been with the company at the main office in Worcester, Mass., for 20 years.

WALTER HASENDAHL has been made Los Angeles representative for the Orton & Steinbrenner Co., manufacturers of cranes, clamshell and orange-peel buckets and coal crushers.

THE MARSH-CAPRON CO., manufacturers of construction equipment, have re-established their own sales organization, placing ROBERT C. VELLER, former general sales manager of the Lockwood Engineering Co., in full charge of the selling force.

THE F. P. LYONS IRON WORKS, Inc., of Manchester, N. H., have established a Boston office in charge of G. S. WALLS and E. K. CARPENTER.

OBITUARY

LAWRENCE B. MCCABE, railroad, bridge and tunnel engineer, died recently at his home in Baltimore. Mr. McCabe was born in Havre de Grace 74 years ago. He was among the first engineering students to matriculate at Lehigh University. He was in partnership with his brother for thirty years, the firm under the name of L. B. McCabe & Bro., having built part of the first subway in New York, the Baltimore Belt Line, and the water tunnel from Loch Raven, Md., to Montebello.

THOMAS HIND, general superintendent of the East Coast Oil Co., died suddenly in Houston, Tex., where he had gone on a business trip. Mr. Hind had been an engineer for the Southern Pacific R.R. for twenty-five years and had recently completed rebuilding the lines which had been destroyed during the disturbances on the Mexican border. Mr. Hind was the author of the article on "Pneumatic Caisson Sinking in Mexico," which appeared in *Engineering News-Record*, Nov. 24, 1921.

HARRY K. SELTZER, for many years vice-president and chief engineer of the Union Bridge Co. of Kansas City, Mo., died suddenly at his home on Dec. 30, 1921. He was widely known for his work on deep bridge foundations on western rivers, particularly the O. W. R. & N. bridge, Portland, Ore., and the Harahan bridge at Memphis, Tenn.

LOUIS HAROLD, superintendent of transportation of the eastern lines, Grand Trunk Railway System, died at Montreal on Jan. 4. Mr. Howard had been with the Grand Trunk Ry. since 1881 and was regarded as one of the most efficient railway engineers in eastern Canada.

FRANK L. GIBBONY, formerly city engineer of Roanoke, Va., died recently in Charlotte, N. C.

Business Side of Construction

Facts and Events that Affect Cost and Volume

World Wholesale Prices

Latest Index Numbers — Decline From High—Peak Generally in 1920

Wholesale prices reached the peak in 1920, except in Germany (1921) and Holland (1918). How prices have moved in America, Europe and Australia since the peak is shown in the accompanying table. "An inspection of the price changes in the countries of the world since June makes it clear that the United States has been the first country in which relative stabilization of the general price level has taken place," says the Federal Reserve Agent, New York. Unsettled financial conditions have caused wide price fluctuations in European countries since June, while in the United States the range has been only four points, according to the Bureau of Labor Statistics. Construction cost has declined 20 per cent since June, according to *Engineering News-Record.*

Country	Latest Quotation	Per Cent Change During November	Per Cent Decline from High	Date of High
United States:				
E. N. R. Construction Cost	169 (Jan. 1)	+ 1.5	38	June, 1920
Federal Reserve	110 (Dec. 24)	+ 1.9	55	May 17, 1920
Department of Labor	149 (Nov. Av.)	— 0.7	45	May, 1920
Dun's	136 (Dec. 1)	+ 0.5	38	May 1, 1920
Bradstreet's	123 (Dec. 1)	— 0.3	46	Feb. 1, 1920
Great Britain:				
Economist	166 (Dec. 1)	— 2.8	47	Apr. 1, 1920
Statist	160 (Dec. 1)	— 1.2	49	May 1, 1920
U. S. Federal Reserve	130 (Dec. 24)	— 7.0	62	May 21, 1920
France	334 (Dec. 1)	+ 0.4	43	May 1, 1920
Italy	595 (Dec. 1)	— 0.7	11	Dec. 1, 1920
Japan	214 (Nov. Av.)	— 2.2	33	Mar., 1920
Canada	169 (Oct. 15)	....	36	May 15, 1920
Sweden†	174 (Nov. 15)	— 0.6	53	Dec. 15, 1918
Australia‡	156 (Oct. Av.)	....	34	Aug., 1920
Norway	274 (Nov. 1)	....	37	Oct. 1, 1920
Germany¶	3,330 (Dec. 1)	+22.2	0	Dec. 1, 1921
Denmark‖	186 (Nov. 1)	....	54	Nov. 1, 1920
Holland	169 (Nov. 1)	....	57	Year, 1918

Index numbers are 100 in 1913, except as noted here. †July 1, 1913 to June 30, 1914 = 100. ‡July, 1914 = 100. ¶Middle of 1914 = 100. ‖July, 1912, to June, 1914 = 100.

Building Mechanics Seventy-Two Per Cent Employed

According to a report made at the recent session of the Mason-Contractors' Association of the United States, 72 per cent of building trade mechanics in 51 cities from which reports were secured, are employed. The apprentice problem Secretary McGarvey of the association pointed out as being very serious, and asserted that reports from 800 contractors in various cities were to the effect that an average of but 20 apprentices were used. This is believed to be a fair average for the United States and Canada. Such a lack of apprentices, coupled with the war and natural causes of incapacitation, have resulted in a shortage of 40,000 bricklayers, according to the association estimate.

We'll make this section what you want it to be—provided you tell us frankly what you want.

Materials and Labor in Buffalo

Price Reductions Expected in Spring—Ample Stocks—Average Lumber Prices of Five Companies

ALTHOUGH it is impossible for *Engineering News-Record* to publish quotations weekly, or even monthly, for all the cities from which requests for this service have been received, still from time to time prices will be published in these pages for centers not covered in the regular price lists. Quotations in every case are gathered first hand by our correspondents staff. This week the Buffalo market is considered, the materials' prices having been obtained from fifteen local sources, and the labor status from the local unions.

Sewer Pipe—While there has been no price decline in the last two months, a slight reduction is expected in the spring. Orders can be filled for immediate delivery, as an ample supply is maintained in the yards. Current prices per foot in carload lots:

3 in.	$0.0930	12 in.	0.4185
5 in.	0.1395	24 in.	1.3950
8 in.	0.2170	36 in.	4.3050

Paving Stone—Prices are unsteady and a drop is expected in the spring. Ample stocks insure immediate delivery from the quarries at Albion, N. Y., at $2.40 per sq.yd. for Medina sandstone.

Sand, Gravel and Crushed Stone—Slight reduction several months ago, but present prices are firm and no further decline expected in the spring. Orders can be filled for immediate delivery. Prices are per ton. Gravel is taken from the Niagara River and costs 75c. f.o.b. Attica, and in Buffalo 95c. and $1.10 for coarse and fine, respectively.

Crushed stone dropped 10c. per ton in 1921, but present prices of $1.50 for winter orders and $1.30 for summer are expected to hold. The winter price is higher because of the extra labor required to thaw the frozen stone and load it onto cars. Ample stocks at quarries in north Buffalo.

Cement—Carloads can be supplied in from three to eight days. The price is $2.34 without bags, f.o.b. city.

Lime—Warehouses well stocked. Hydrated finishing at $15 per ton; common lump $2.60 per bbl.

Brick—Immediate delivery of common brick from nearby plants. Reduction expected in spring from present range of $17@$18.50. Paving brick and blocks are obtainable in 10 days at $30 and $41, respectively.

Hollow Wall Tile—Adequate stocks in yards at following prices per 1,000: 4 x 12 x 12, $79; 8 x 12 x 12 (4 cell), $135, (6 cell) $153; 12 x 12 x 12 (4 cell), $211, (9 cell) $229.

Lumber—Prices are firm at present but reduction is expected in spring, particularly if freight rates are cut. Carload lots are obtainable in from three to six weeks. The following quotations are the average of figures submitted by five local companies:

Yellow Pine,	1 in. rough, 10 in. and under, 16 ft. and under	$38
Fir	1 in. rough, 10 in. and under, 16 ft. and under	45
Hemlock	1 in. rough, 10 in. and under, 16 ft. and under	36
Yellow Pine,	2 in. tongue-and-groove, dressed and matched, 10 in. and under, 16 ft. and under	36
Fir,	2 in. tongue-and-groove, dressed and matched, 10 in. and under, 16 ft. and under	50
Yellow Pine,	8 x 8 in. and under, 20 ft. and under	43
Fir	8 x 8 in. and under, 20 ft. and under	46
Hemlock	8 x 8 in. and under, 20 ft. and under	45
Spruce	8 x 8 in. and under, 20 ft. and under	45
Yellow Pine,	12 x 12 in., 20 ft. and under	46
Fir	12 x 12 in., 20 ft. and under	50

Manila Rope—Price advanced 2c. per lb. in November, 1921, and is unsteady. Large stocks at 19c. per lb. for ¾-in. and larger, 19½c. for ⅝-in.

Miscellaneous—Asphalt is not bought in Buffalo. Wood blocks are not handled in the city and there is little demand.

Explosives — Price of dynamite dropped 25c. per 100 lb. in August, 1921, black powder dropped 10c. per keg. Warehouses carry from two to six carloads. Prices per 100 lb. 20 per cent low-freezing $22.75; 40 per cent gelatin, $22.75; 60 per cent, $29.25; 80 per cent, $33.50; black powder per keg, $2.60.

LABOR RATES AND AVAILABILITY

	Per Hour	Supply
Bricklayers	$1@$1.10	Fair
Carpenters	85 @ 87½c.	Fair
Hoisting Engineers	$1	Plentiful
Hodcarriers	40c.	Plentiful
Dockbuilders	81c.	Fair
Piledrivers	90c.	Fair
Foremen	$46.50 per week	.....
Structural Iron-workers	$1	Plentiful
Common Labor	30 @ 35c.	Plentiful

Next Week — Construction Outlook for Spring; Contracts Let Since Oct. 1, 1921, in the Important Sections of the Country.

142 Contractors Bid on Nine New York Road Jobs

Perhaps the keenest competition that has yet been recorded among Eastern highway contractors was in evidence on Jan. 10, when bids were submitted to the New York State Commission of Highways for the construction of 44.5 miles of highways an entailing expenditure around $1,300,000. The mileage was split up into nine contracts. The 142 contractors who presented bids seemed to prefer jobs which called for the construction of mileages around 5, for on one job of 5.89 miles twenty-six men bid; and on another of an even 5 miles twenty-three bid. On a shorter job of 2.10 miles twenty-eight contractors bid. On two other jobs eight bids each were submitted, on another nine bids, on two more eleven each, and on the ninth eighteen bids were received. This makes an average of about sixteen bidders per job.

The engineer's estimate on the total 44.5 miles was in excess of $1,500,000 or an average of about $35,000 per mile. The total high bid was about $500 per mile less than the estimate and in only one case did the high bid equal the estimate of the engineer, in all other cases it being materially lower. The total low bid amounted to $1,300,336, or an average of about $29,000 per mile.

Congress Considers Menace of Tax-Exempt Bonds

The swelling flood of tax-exempt public bond issues has reached sufficiently serious proportions to cause Secretary Mellon of the Treasury to urge prompt passage of the McFadden resolution proposing a constitutional amendment prohibiting further issuance of such securities. Representative McFadden, chairman of the House Banking and Currency Committee, declared that credit is being impaired because of the enormous issues of the tax-exempt bonds. He continued:

"The issuance of tax exempt securities by the Government, the States and their political subdivisions makes possible the creation of two classes—the wealthy, free from the burdens of taxation, and the workers, who are forced to bear the burden of which the wealthy are relieved.

"If the issuance of tax exempt securities is allowed to continue, a social upheaval will occur which may be so far reaching in its effect as to undermine our constitutional Government.

"It has been estimated that approximately $15,000,000,000 of tax-exempt securities have been issued by the Government, States and political subdivisions. Of this about half represents the debt of States, cities, school districts and other political subdivisions, while the balance represents the obligations of the Government."

Masons Reduce Own Wages

A considerable decrease in the price of building materials is given as the reason for a voluntary reduction in wages of the Bricklayers' and Masons' Union of Cumberland, Maryland. The Cumberland masons have agreed to work for $1.12½ an hour, thus cutting their own wages 12½ cents an hour.

Year End Lumber Statistics

Reports for the final weeks of 1921 in the lumber industry show orders and production double those for the corresponding week in 1920 according to A. Fletcher Marsh, statistician of the American Wholesale Lumber Association. For the entire year orders exceeded production by 4 per cent and shipments exceeded production by 1 per cent. Southern pine orders and shipments exceeded production by 4 per cent but the production was 28 per cent under the normal cut. On the West Coast the cut was only two-thirds of normal for this season.

Representative Public Bond Sales in December

Sales of long-term municipal issues aggregated nearly $211,000,000 for December, as against $55,476,631 for December, 1920. This record total includes the $55,000,000 New York City issue of 50-year 4½ per cent gold corporate stock. Among the numerous municipal enterprises of the month were: Chicago, $7,725,000—5s; Buffalo, $7,630,000—4½s; and Jersey City, $3,500,000—5s. Following are some representative sales:

REPRESENTATIVE BOND SALES OF DECEMBER, 1921

State	Purpose	Amount	Maturity	Rate per Cent	Sold for	Dated
Louisiana	Penitentiary	$1,000,000	1–20 year serial	5	103.31	Jan. 1, 1922
Oregon	Road	58,000	.....	6	95.689	Nov. 28, 1921
County						
Allen, Ohio	Highway Imp'vt.	100,000	1922–26	6	100	Sept. 1, 1921
Baker, Ore.	Road	110,000	.....	5	103.35	Dec. 28, 1921
Douglas, Neb.	Road Paving	1,000,000	1937–41	5	100	Oct. 1, 1919
Douglas, Wis.	.....	20,000	.....	5	100	.....
Dugeness Irrigation District, Challam Co., Wash.	Irigation	23,000	Semi-annual	6	90	.....
East Lake Special Road and Bridge Dist., Florida.	Road and Bridge	600,000	.....	5	97.25	July 1, 1921
Fayette, Pa.	Highway	500,000	1941	4.75	106.156	Dec. 30, 1921
Freeborn, Minn.	Ditch	300,000	1928–42	4.75	101.	Jan. 2, 1922
Jasper, Ind.	Ditch Canal	12,817	.....	6	103.12	June 1, 1921
Knightsen Irrigation District, Contra Costa Co., Calif.	Irrigation	100,000	.....	6	94.10	Dec. 27,1921
Lake, Ill.	Road	900,000	1939	5	102.04	Nov. 4, 1919
Marion, Ore.	Road	200,000	$30,000–1928 $85,000–1929–30	5.5	102.43	July 15, 1920
Merced Irrigation District, Merced Co., Calif.	Irrigation	3,120,000	1933–50	6	103.28	Jan. 1, 1922
Municipality						
Allentown, Pa.	Sewer	130,000	.....	4.5	101.47	Jan. 1, 1922
Avon Lake, Ohio	Road Improvem't.	10,000	1923–27	6	100	Oct. 1, 1921
Canton, Ohio	City Improvement.	13,850	1931	6	100	Mar. 1, 1921
Cresskill, N. J.	Street Improvem't.	22,000	$1,500–1923–26 $2,000–1927–34	6	103.34	Jan. 1, 1922
Cumberland, Md.	Gen'l. Improvem't.	250,000	Due $25,000 annually	5	107.43	July 1, 1920
Elmsford, N. Y.	Water System	150,000	$6,000 annually 1925–49	5.5	100.23	Dec. 31, 1921
Ft. Lauderdale, Fla.	Water Extension	27,000	1942	6	94.13	Nov. 1, 1921
	City Hall	15,000				
	Street Improvem't.	12,500				
	Park	5,000				
Fremont, Neb.	Water Extension	30,000	1941	6	100.00	July 1, 1921
Groton, S. Dak.	Water works	40,000	1941	6	101.08	Nov. 1, 1921
	Electric light	40,435				
Indianapolis, Ind.	Sanitary District	250,000	1926	6	104.65	Dec. 30, 1921
Lansing, Mich.	Electric Light	500,000	1930–36	4.75	101.14	Jan. 3, 1922
	Paving	200,000	1923–27	5	101.14	
	Sewer	100,000	1923–27	5	101.14	
	Bridge	100,000	1928–32	5	101.14	
Lincoln, Neb.	Water Wks. Ext.	100,000	1933 and annually thereafter	5	102.647	Jan. 1, 1922
Miami, Fla.	Dock	300,000	$5,000–1936–50 $225,000–1951	5.25	99.36	Jan. 1, 1922
	Street Railway	100,000	$10,000 ann. 1927–36			
New Brunswick, N. J.	Water	63,614	1923–51	5.5	109.682	Dec. 1, 1921
Tarboro, N. C.	Street Improvem't.	64,000	1923–38	6	100.00	Nov. 29, 1921
	Electric Light	35,000	1923–51			
Winnetka, Ill.	Filtration	86,000	1922–39	5	96.00	May 10, 1921

Trend of Business

Bonds—Fewer offerings have given the market an upward price tendency. Municipals less active. Victory bonds and the Fourth Liberty exceeded the previous high in the open market. Railroad bonds strengthened. Copper issues stronger owing to announcement that Anaconda expected to resume mining operations Feb. 1.

Money—Call loan rates average 3½ per cent, against 3½@5½ in the previous week, which is lowest since 1918. Money was plentiful last week, with demand light.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called in Construction News, pp. 21@29, are the following:

A Capitol building for Sacramento, $3,000,000.

A warehouse at Louisville, $1,500,000.

An excavation and dredging project at Ortonville, $1,371,000.

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 21@29, are the following large projects: A 15-story apartment hotel in Kansas City, Mo., under supervision of P. J. Branshaw, International Life Bldg., St. Louis, $1,000,000; a railway development from Cochrane to New Post, Ontario, $3,000,000.

Pacific Northwest Lumber Demand Strong

Demand for fir in the Pacific Northwest was unusual for the week ending Dec. 24, showing an increase of 10,000,000 ft., when the holiday season in other years has shown a sharp let-up of orders. Compared with 1920 the week's bookings were four times as great. A. Fletcher Marsh, statistician for the American Wholesale Lumber Association, reports orders 71 per cent of normal but only 310 out of an average of 375 mills reporting.

The increase in West Coast business was due apparently to the knowledge of a severe log shortage due to bad weather making customers come early into the market. Rail orders have increased since December 17,000,000 ft. out of a total increase of 24,000,000 ft. for both rail and cargo shipments.

New business for the combined associations was more than twice what it was a year ago. In yellow pine the 1921 volume was 150 per cent of 1920.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of January 5; the next, on February 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.53	$3.50	$4.00	$2.88	$2.91	$3.50	—$3.10	$3.85	$4.00
Structural rivets, 100 lb	3.50	5.00	5.50	3.43	3.90	4.25	4.50	4.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.53	3.20	3.50	2.68	2.81	—3.37½	—2.75	3.75	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	57.65%	45%	57%	61.9-5%-	-44%	53.7%	55%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	45.00	48.30	44.10	47.80	52.00	50.00	55.00	60.00
Concreting Material:									
Cement without bags, bbl	2.30	2.55	2.55	1.97	2.24	2.90	2.84	2.94	3.10
Gravel, ¾ in., cu.yd	1.75	1.85	2.00	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.25	2.00	2.00	.50	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75@1.85	2.00	2.93	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	35.00	34.00	43.00+	38.00	—45.00	32.00	19.00	.....
Lime, finishing, hydrated, ton	16.99	19.00	25.00	18.00	29.00	30.00	22.00	27.00	21.00
Lime common, lump, per bbl	3.00@3.49	1.50	2.75	1.40	1.40	2.95	—1.75	2.75	11.00
Common brick, delivered, 1,000	+18.40	9.00	12.65	11.00	15.00	14.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0675	.13	.0821	.0752	.08	.12½	.10	.08
Hollow partition tile 4x12x12, block	.11120	.0675	.13	.0657	....	.10	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	+.73	.78	.93	.76	+.84	+.91	.83	.79	.85
Common Labor:									
Common labor, union, hour	.75	.35	.....	.72½	—.40	.50@.55	.62½	.50@.60	.....
Common labor, non-union, hour	.....	.20	.35@.45	.35@.40	—.40	.35@.40	.56¼	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars. Gravel, sand and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net.

Montreal quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 94.7 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Structural shapes and reinforcing bars at the Pittsburgh mills, continue at $1.50 per 100 lb. San. Francisco warehouses quote steel shapes at $3.10 as against $3.45. Slackening of business activities and efforts to get back to prewar prices have given rise to a reduction of 20c. on reinforcing bars in Denver warehouses and 25c. per 100 lb. in San Francisco. Denver quotes a discount of 44 per cent on black steel pipe as against 41 per cent, one week ago.

A drop of $5 per M. ft. b.m. in Douglas fir, base sizes, is quoted in Denver and 15c. per bbl. (180 lb. net) on common lump lime in San Francisco.

A fairly active demand for the principal construction materials continues, regardless of the season of the year. Activity in brick shipments has caused a return to the wholesale price of $15 per 1000 and the impending spring demand for paint materials is suggested in the price rise on linseed oil in Denver and New York.

The wholesale lumber demand in the East coast centers shows no perceptible decrease.

The West Coast Lumbermen's Association reports, for the week ending Jan. 7, 1922 as compared with the week ending Dec. 31, 1921, a falling off of 9,842,657 ft. in sales; increases of 7,083,873 ft. in shipments and 20,200,859 ft. b.m. in production.

The Builders Exchange of London, Ontario, has ordered a 15 per cent reduction in the building trades wage scale, effective Feb. 1, 1922. The new schedule awards bricklayers and plumbers 85c.; lathers and carpenters 70c.; sheet metal workers, painters, electricians and roofers 60c. and laborers 40@55c. per hr.

Local planing mills have cut wages 10 per cent and the average cost of building materials has been reduced 25 per cent.